- **Teams may have the following:**

  - One stand-alone, non-programmable, non-graphing calculator.
  - One hard copy 8.5" x 11" sheets of paper with information from any source. Electronic notes are fine to use.

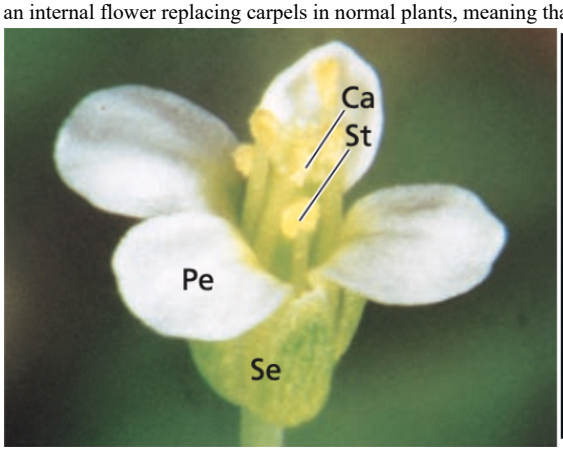
- **Partial credit will be awarded accordingly.**
- **(Free Responses) Make sure that you are answering a question on the corresponding space given on the answer sheet!**
- **If you are not certain as to what you should be doing, or if a question does not make sense to you, ask the event supervisor what to do.**

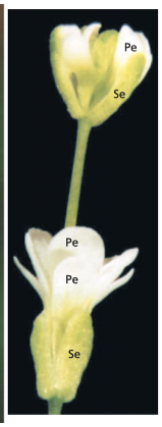
- **For fill-in-the-blank questions, assume your answer to be singular unless you're given different instructions.**
- **Be realistic in all of your answers. Think biologically and environmentally!**
- **You have 50 minutes to complete this test. Good luck!**

1. (1.00 pts)
In Theophrastus' famous book, *Enquiry Into Plants*, one of the 10 books on the natural history of plants describes it's medicinal uses. For example, hemlock is a poison that gives a painless death; pepper is its antidote. Which of the following plants can be used to expel a woman's placenta?

- A) Strykhnos
- B) Peony
- C) Frankincense
- D) Birthwort

2. (1.00 pts)
Look at the images provided above (left, normal; right, abnormal). According to the ABC Hypothesis in flower development, this abnormal *Arabidopsis* flower seems to have an internal flower replacing carpels in normal plants, meaning that there is a mutation in which of the following genes.





- A) A
- B) B
- C) C
- D) None

3. (1.00 pts) Which of the following phytopathogenic diseases is on a tree in the picture below?

- A) Apiosporina morbosa
- B) Thousand Cankers
- C) Black Knot
- D) Anthracnose

4. (1.00 pts) Cedar-apple rust is an example of a disease caused by a fungus with a polycyclic life cycle.

- True
- False

5. (1.00 pts) What is the production of fruit without any seeds called?

6. (1.00 pts) A. tumefaciens genes force plant cells to produce which of the following plant hormones?

- A) Auxin and Cytokinin
- B) Auxin and Gibberellin
- C) Cytokinin and Ethylene
- D) Gibberellin and Testosterone
- E) Abscisic acid and Ethylene

7. (1.00 pts) Powdery mildew can be wiped off of the surface of a plant, making it easy to control without the use of a fungicide.

- True
- False

8. (1.00 pts) Which of the following is **not** an agent that interferes with oxidation phosphorylation or photophosphorylation?

- A) Myxothiazol
- B) Amytal
- C) Rotenone
- D) Ubiquinone

9. (1.00 pts) What part of a plant's chloroplast does the Calvin Cycle take place?

- A) Inner membrane

B) Outer membrane

C) Thylakoid

D) Stroma

10. (1.00 pts)
In [answer], CO_2 is first fixed in mesophyll cells into oxaloacetate then malate, which then passes into bundle-sheath cells and releases CO_2 in high concentrations.

A) C2 plants

B) C3 plants

C) C4 plants

D) CAM plants

11. (1.00 pts) Where would one look for oxygen production in photosynthesis?

A) Hack and Slack cycle

B) Cyclic phosphorylation

C) Noncylic phosphorylation

D) Calvin Cycle

12. (1.00 pts) Which of the following enzymes helps an excited Photosystem I (PSI) pass its electrons from ferredoxin to NADP+.

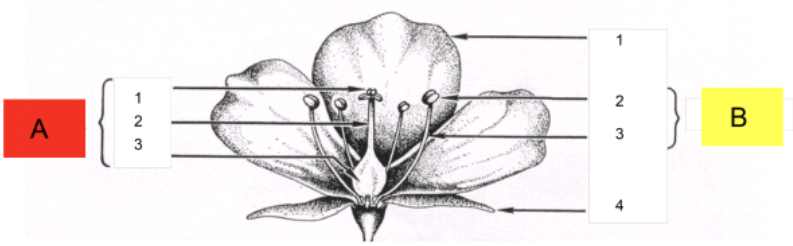
A) PQa

B) FNR

C) PQb

D) Plastocyanin

13. (1.00 pts) The following question will test your knowledge of this flower's anatomical parts. Read all of the provided choices then select the **incorrect** answer.



A) A3; contains one or more ovules that develop into seeds once fertilized.

B) B2; male reproductive part which contains pollen.

C) B4; collectively called the calyx.

D) A1; a source of nectar that attracts insects and birds.

E) A2; often sticky from which pollen germinates.

14. (1.00 pts) Inflorescence is a botanical term used to describe the arrangement of different plants, in this case, flowers. What type of inflorescence flower is this?

A) Panicle
B) Raceme
C) Compound cyme
D) Compound umbel
E) Corymb

15. (1.00 pts) Compare the plant in the previous question to a cycad. Which of the following scientific classifications is unique to a cycad?

A) Eukaryota
B) Spermatophyte
C) Gymnospermae
D) Trachophytes
E) Eudicots

16. (1.00 pts) Plastic mulches are not effective for evaporation control because they are not biodegradable.

True False

17. (1.00 pts) Which of the following viruses is used for the bio-control of insect pests in plants?

A) Rice Tungro Virus
B) Nuclear Polyhedrosis Virus
C) Cucumber Mosaic Virus
D) Tomato Mosaic Virus

18. (1.00 pts) Which of the following is not an adaptation of a hydrophyte?

A) There exists a poorly developed root system.
B) There is less parenchyma in the stem.
C) Stomata found on the upper leaf surface.
D) There are fewer cuticles over the epidermis by comparison.

19. (1.00 pts) Which of the following is not an adaptation of xerophytic plants?

A) Presence of palisade-like tissue in the stem
B) Presence of thick cuticles
C) Adopts the CAM cycle for photosynthesis

D) Large leaves are present

20. (1.00 pts)
Black mustard seeds (*Brassica juncea*) are edible and used as the phytoremediation agent for the removal of which of the following heavy metals found in the soil?

A) Lead
B) Cadmium
C) Nickel
D) Arsenic
E) Copper

21. (1.00 pts) Which of the following routes allow water and minerals to diffuse into the cortex along the matrix of walls and extracellular spaces?

A) Symplastic
B) Transmembrane
C) Apoplastic
D) Xylemic
E) Vascular

22. (1.00 pts) This discolored leave exhibits a disease that is common in acidic or sandy soils, indicating which macronutrient deficiency?

A) Mg 2+
B) K+
C) Ca 2+
D) SO4 2-

23. (1.00 pts) The Mistletoe plant would be most closely associated with which of the following symbiotic relationships?

A) Commensalism
B) Mutualism
C) Parasitism
D) Recidivism
E) Amensalism

24. (1.00 pts) Plants that grow under direct sunlight and called [Answer 1], and those growing under shade are called [Answer 2].

A) Heliophytes and Psamophytes
B) Psamophytes and Heliophytes
C) Sciophytes and Psamophytes
D) Heliophytes and Sciophytes

25. (1.00 pts) In callus culture, higher concentrations of auxin rather than cytokinin induce the formation of which plant structure?

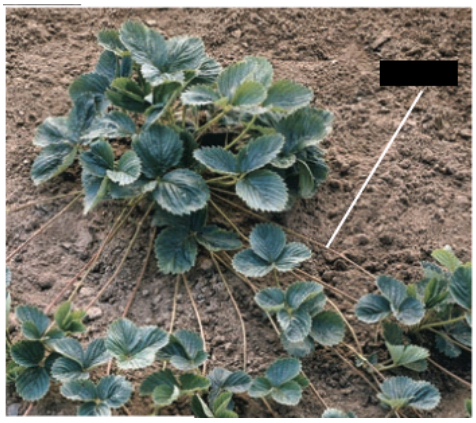
- A) Adventitious Shoot
- B) Adventitious Root
- C) Bothe Root and Shoot
- D) None of the Above

26. (1.00 pts)
Mangrove trees inhabiting low tides and growing in oxygen-poor waters develop unique root systems such that their roots appear in the air. What are these roots known as?

- A) Buttress roots
- B) Strangling aerial roots
- C) Pneumatophores
- D) Prop roots

27. (2.00 pts)
The evolutionary adaptation of stems by plants is quite unique. Whether for food storage or asexual reproduction, plants develop modified stems that are often mistaken for roots.

- Identify the following modified stem in this image below:



(Mark **ALL** correct answers)

- [ ] A) Stolons
- [ ] B) Tendrils
- [ ] C) Runners
- [ ] D) Suckers
- [ ] E) Offsets
- [ ] F) Bulbs

28. (1.00 pts) Lateral plant roots stem from which of the following plant structures?

- A) Pith
- B) Endodermis
- C) Cortex
- D) Pericycle

29. (1.00 pts) Narrowed xylem cells with lignified walls that help with water transportation.

- A) Endodermis
- B) Collenchyma
- C) Sclerenchyma
- D) Tracheids

○ E) Periderm

30. (2.00 pts) Which of the following describes connation in flowers?

- **Select the correct answer(s):**
  1. Styles connected to stamen
  2. Petals connected to each other
  3. Pistil connected to stamen
  4. Carpels connected to each other

(Mark **ALL** correct answers)

☐ A) 1

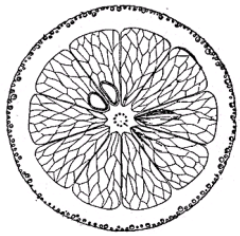
☐ B) 2,3

☐ C) 1,4

☐ D) 2,4

☐ E) 4

31. (1.00 pts) Which of the following correctly identifies the taxonomical category of the following image?



○ A) Achenes

○ B) Drupe

○ C) Pepo

○ D) Hesperidium

○ E) Cirkusis

○ F) Pome

32. (1.00 pts) Which of the following came second in plant evolution?

○ A) Non-vascular plants

○ B) Conifers

○ C) Seedless vascular plants

○ D) Flowering plants

33. (2.00 pts) Plants that can switch between C3 and CAM mode are called _____ _____. **C**apitalize the first word. **C**apitalize the entire second word (acronym).

34. (1.00 pts)
A microbe found on a plant with Erwinia carotovora may have caused a certain disease but you cannot find published information verifying this. Which procedure do you follow to determine whether this pathogen caused that disease?

○ A) Fungal determinant.

○ B) Karnal's rules.

○ C) Draw numbers out of a hat.

○ D) Koch's postulates.

○ E) Moist chamber.

35. (2.00 pts) Which of the following diseases does the previous question's microbe cause?

(Mark **ALL** correct answers)

- [ ] A) Aster yellows
- [ ] B) Soft rot
- [ ] C) Apple scab
- [ ] D) Slime flux
- [ ] E) Corn smut

36. (1.00 pts) Fireblight initially evolved in which continent?

- ○ A) Asia
- ○ B) North America
- ○ C) South America
- ○ D) Europe

37. (1.00 pts) Biodiesel is obtainable from which plant?

- ○ A) Prosopis
- ○ B) Catharanthus
- ○ C) Calotropis
- ○ D) Jatropha curcas

38. (1.00 pts) A biodiversity hotspot is characterized by which of the following concepts?

- ○ A) Endemic plants
- ○ B) Threat perception
- ○ C) Endemic flowering plants
- ○ D) Species flowering plants

39. (1.00 pts) Which of the following ecosystem has the longest energy transfer time?

- ○ A) Open ocean
- ○ B) Tropical rain
- ○ C) Temperate deciduous
- ○ D) Desert

40. (1.00 pts)
Gibberellic Acid (GA) controls seed germination by directing breakdown of the stored starch. Which of the following barley seed tissues does the α-amylase gene is induced in respond to GA?

- ○ A) Endosperm
- ○ B) Coleoptile
- ○ C) Aleurone layer
- ○ D) Embryo

41. (1.00 pts)
Nitrogen fixation is a process where nitrogen gas is converted into ammonia. One of the key enzymes in this process is nitrogenase. Which of the following statements best highlights the production and activity of nitrogenase?

1. Nitrogen fixation through nitrogenase is an energetically expensive process.
2. Nitrogenase encoding gene is under a consitutive promoter.
3. Nitrogenase is highly sensitive to oxygen.
4. Endogenous availability of the cofactor of nitrogenase enzyme is very low.

- ○ A) 1 and 2

B) 1 and 3
C) 2 and 3
D) 2 and 4

42. (1.00 pts) The bending of an oat coleoptile tip towards the source of unilateral light of wavelength 454 nm is due to which of the following?

A) Synthesis of auxin in the shaded area.
B) Lateral distribution of auxin toward shaded area
C) Degradation of auxin in the light area.
D) Polar transport of auxin.

43. (1.00 pts) The hydrostatic opening of stomata is due to which of the following?

A) Movement of K+ ions into guard cells.
B) Low water potential in mesophyll cells.
C) Movement of water into guard cells.
D) Decreased concentration of ABA.

44. (1.00 pts) Which of the following are regulators of plant circadian rhythms?

A) Phototropins
B) Cryotophores
C) Phycobilins
D) Phytochromes

45. (1.00 pts) What type of fruit is a pineapple?

A) Berry
B) Aggregate
C) Dehiscent
D) Multiple

46. (1.00 pts) What are the paired outgrowths typically found alongside the petiole attachment to the stem called?

A) Stipules
B) Crazy twig
C) Areoles
D) Lenticels

47. (1.00 pts) Certain plants have an anatomical feature called a holdfast. Such a plant would be associated with which biome?

A) Desert
B) Ocean
C) Tropical rainforest
D) Tundra

48. (1.00 pts) Abscission in a plant would be associated with which of the following process?

A) Germination
B) Reproduction
C) Growth
D) Defoliation

49. (1.00 pts) Which of the following is an example of an organ of perennation in plants?

A) Rhizome
B) Seed
C) Petal of a flower
D) Calyx of a flower

50. (1.00 pts) Which of the following statments is correct?

A) Plants absorb carbon dioxide and only release oxygen.
B) Plants absorb carbon dioxide, and release oxygen and carbon dioxide.
C) Plants absorb carbon dioxide and oxygen, and release oxygen and carbon dioxide.
D) Plants absorb oxygen and only release carbon dioxide.

51. (1.00 pts) The embryonic portion of the seed is called the radicle is associated with which of the following plant parts?

A) Fruiting body
B) Root
C) Leaf
D) Stem

52. (1.00 pts) What plant is known as the smallest flowering plant? **Hint:** Has two tiny vascular roots. **Capitalize the first letter of the first word. One-word answer.**

53. (1.00 pts) Thorns are found on many different plants but biologically are not modified leaves.

True False

54. (1.00 pts) What is the symbiotic relationship between various fungi and plant roots called? **Capitalize the first letter of the first word. One-word answer.**

55. (1.00 pts) The relationship described in the previous question occurs in what percentage of plants?

A) 50%
B) 70%
C) 80%
D) 90%

56. (1.00 pts) Some plants produce an underground stem that is almost entirely stem tissue. Which of the following option refers to such a growth?

A) Corm
B) Rhizome
C) Stolon
D) Tuber

57. (1.00 pts) Which of the following was not restricted to the Western Hemisphere until 1942?

A) Banana
B) Cacao
C) Potato
D) Pepper

58. (1.00 pts)
The photosynthetic process can only make use of a fraction of the total energy in sunlight. For a "typical" plant, how much of sunlight is in the photosynthetically active wavelength range?

- A) 65%
- B) 55%
- C) 45%
- D) 35%

59. (1.00 pts) Which macroscopic group of marine plants is the most diverse and abundant?

- A) Chrysophyta
- B) Phaeophyta
- C) Pyrrophyta
- D) Rhodophyta

60. (1.00 pts) Sedges superficially resemble grasses. Which of the following statements does not accurately describe the differences between grasses and sedges?

- A) Sedges have triangular stems with leaves that are arranged in three ranks.
- B) Sedges have hollow stems.
- C) Sedge leaves confined to the base and/or top of the plant.
- D) Sedges have specialized flowering structures.

61. (1.00 pts) Periphyton is a type/group of plants that would be associated with which of the following settings?

- A) Sand dunes
- B) Tropical/Semitropical forests
- C) Rivers/Streams
- D) Tundras

62. (1.00 pts)
Many trees, mostly gymnosperms, do not release their seeds until exposed to high heat, such as a fire. Such a cone is described as? **Capitalize the first letter of the first word. One-word answer (adjective).**

63. (1.00 pts) Which color light is the most important for plant growth and flowering?

- A) Blue and Red
- B) Green and Blue
- C) Red and Green
- D) Orange and Red

64. (1.00 pts) Which of the following reasons correctly describes why coffee plants produce caffeine?

- A) As an energy storage mechanism.
- B) As a pesticide to ward off insects.
- C) As a means to help survive extended dry periods.
- D) As an astringent to discourage grazing animals.

65. (1.00 pts)
If you were a chiropterophilus plant, you would have adapted yourself to attract the attention of what organism for pollination? **Capitalize the first letter of the first word. One-word answer.**

66. (1.00 pts) Any response of a plant to the relative lengths of daylight and darkness. **Capitalize the first letter of the first word. One-word answer.**

67. (1.00 pts) Which of the following trees are well known for allelopathy?

- A) Oak
- B) Walnut
- C) Beech
- D) Pecan

68. (1.00 pts)
California is one of the nation's largest agricultural producers. Agriculture in California is faced with the constant (and growing) challenge of limited water supply. Which of these crops is the largest consumer of water (total aggregate volume) in that state?

- A) Rice
- B) Vineyards/Wine
- C) Citrus
- D) Almonds/Pistachios

69. (1.00 pts) What medication (common name) was first identified from the bark of the willow tree? **Capitalize the first letter of the first word. One-word answer.**

70. (1.00 pts) What are the oldest living trees on Earth called?

- A) Bristlecone Pines
- B) Gingko
- C) California Sycamore
- D) Utah Juniper

71. (1.00 pts) Which soil is rich in organic debris?

- A) Loam soil
- B) Humus soil
- C) Saprophyte
- D) Sandy soil

72. (1.00 pts) Which of the following is not considered to be a true fruit?

- A) Date
- B) Plum
- C) Apple
- D) Grape

73. (1.00 pts) What is the term used to describe "land plants"? **Capitalize the first letter of the first word. One-word plural answer.**

74. (1.00 pts)
What group of plants is distinguishable from all other plant groups by the complete absence of stomata? **Capitalize the first letter of the first word. One-word plural answer.**

75. (1.00 pts) Which one of the following is not associated with stomata?

- A) Water
- B) Oxygen
- C) Carbon Dioxide
- D) Hydrogen

76. (1.00 pts) Which of the following are not a basic growth form of lichen?

- A) Foliose
- B) Fructose
- C) Crustose
- D) Glucose
- E) Fruticose

77. (1.00 pts) What is the name for a fire that runs through the tops of living trees or bushes? **Capitalize the first letter of the first word. One-word answer.**

78. (1.00 pts) What type of "fruit" structure is produced by an American Elm? **Capitalize the first letter of the first word. One-word answer.**

79. (1.00 pts)
Dead empty tubes that make up the largest component of conifer wood (90-94% of volume) are known as what? **Capitalize the first letter of the first word. One-word plural answer.**

80. (1.00 pts) How many molecules of carbon dioxide are needed in photosynthesis to produce one glucose molecule?

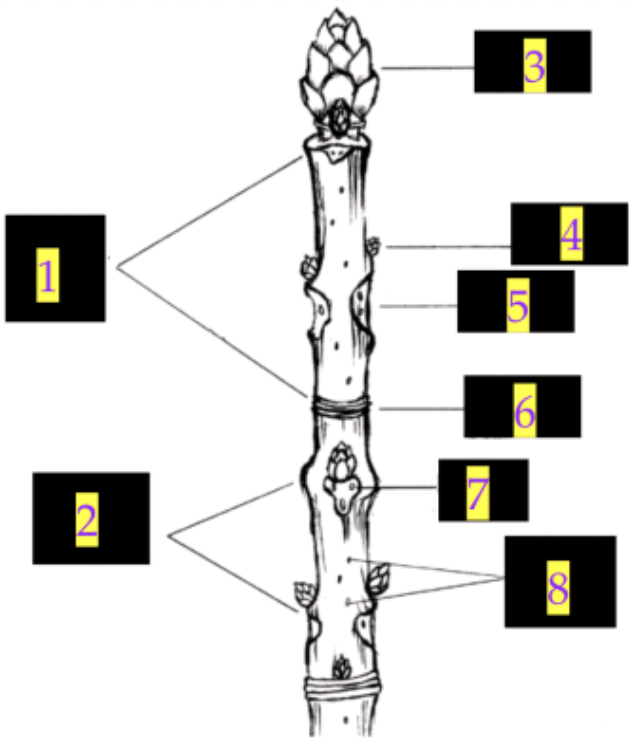
- A) 4
- B) 6
- C) 2
- D) 12
- E) 3

81. (8.00 pts)

Stem Characteristics

Plant Anatomy

- From the left column down then right column down, identify the following stem parts which are numerically classified. **Number** each answer in order to make grading more convenient.



Hint: Answer for Number 1 = "Last year's growth"

BeLeaf In Yourselves

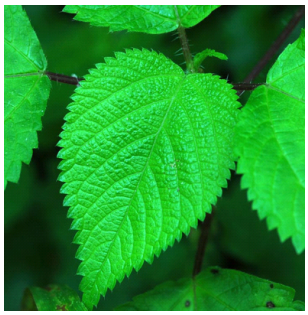
Plant Anatomy

The following questions will test your knowledge on leaves (e.g. shapes, margins, tips, bases). Answer them to the best of your ability. **Capitalize the first letter of the first word for each answer.** For example, **Bipinnately compound** rather than **Bipinnately Compound**.

82. (1.00 pts) Which of the following leaf bases describes the leaf image below?

- A) Peltate
- B) Truncate
- C) Dentate
- D) Sagittate
- E) Hastate

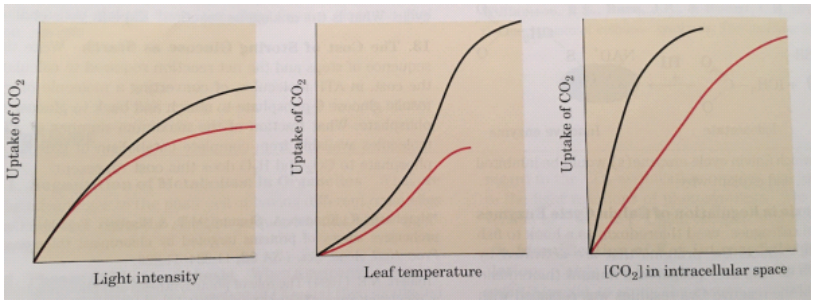
83. (1.00 pts) Type the answer that describes the leaf margins in this picture below. **Remember to capitalize the first letter only. One-word answer.**



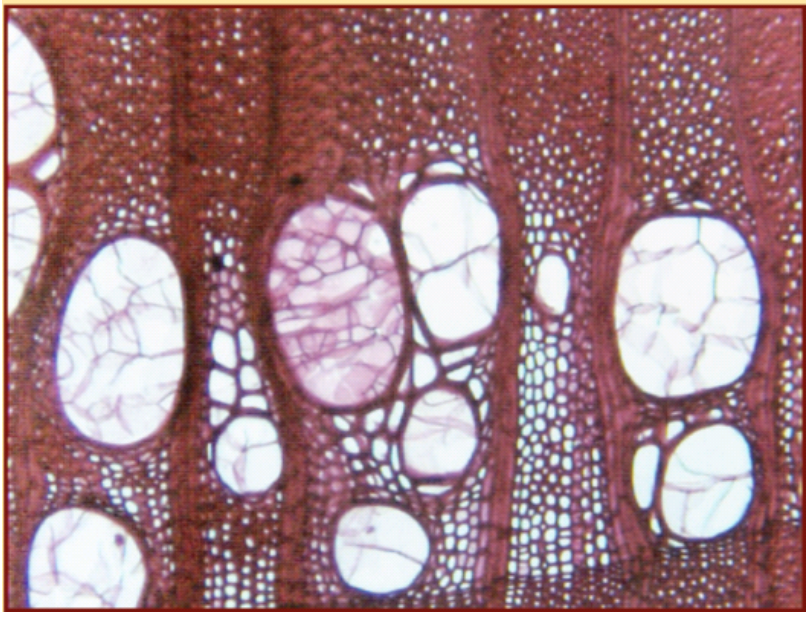
84. (2.00 pts) Identify this leaf shape followed by its venation. **First answer should be the leaf shape. Second answer should be its venation type.**

85. (7.00 pts) The plant genus *Alternanthera* includes some C3 and C4 species.

- From the three graphs below, **identify** and **justify** which species is a C3 plant and which is a C4 plant. Species 1, upper curve; Species 2, lower curve.
- **Name** <u>one</u> C3, C4, and CAM plant.



86. (10.00 pts) Below is a microscopic transverse image of the native bla*ck* locust *(Robinia pseudoacacia)* displaying a plant condition.



- **Name** the growths around these vessels <u>and</u> **identify** their relative location.
- **Describe** how these growths are formed.
- **Reason** why these growths are formed.
- **What** role do ergastic substances play? **Include** two ergastic substances in your answer.
- **Describe** how this relates to CODIT.

87. (2.00 pts) Below is an image of the effects of **Dutch Elm Disease** spread by elm beetles.

- In your own words, **describe** <u>two</u> preventable management treatments that can control the spread of **Dutch Elm Disease**.

88. (4.00 pts)

Seed dormancy is caused by inner or outer embryonic conditions activated by survival mechanisms (e.g. physiological, mechanical, chemical). Abscisic acid is a chemical inhibitor responsible for delayed seed germination. Well, actually, the ratio of abscisic acid to gibberellins determines whether a seed germinates or remains dormant.

- **Describe** <u>two</u> **human** practices of breaking seed dormancy to promote and ensure successful germination?

89. (12.00 pts)

C4 and CAM Plants

Plant Photosynthetic Pathways

Evolution helps us explain how succulent cacti and pineapple continue to thrive on counterproductive (arid and barren) environments.

> On a hot, dry day, most plants close their stomata, a response that conserves water but also reduces CO_2 levels. With stomata even partially closed, CO_2 concentrations begin to decrease in the air spaces within the leaf, and the concentration of O_2 released from the light reactions begins to increase. These conditions within the leaf favor an apparently wasteful process called photorespiration.

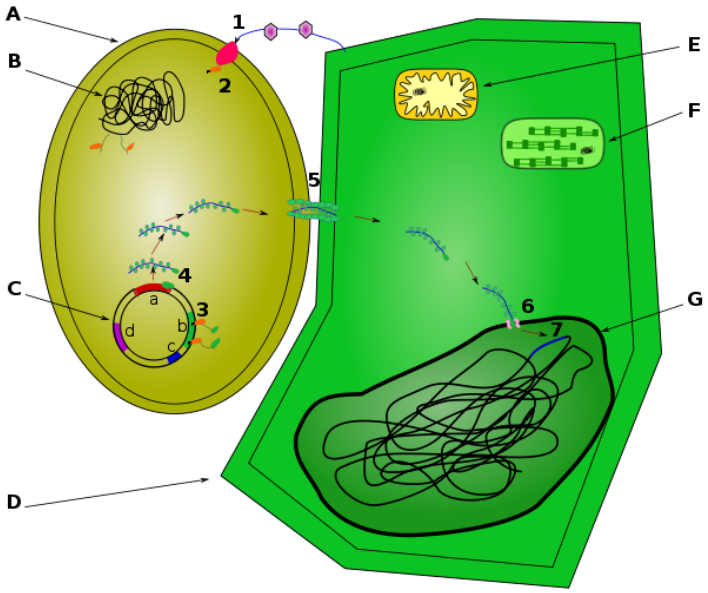
- **Explain** how the **C4** and **CAM** pathways are two evolutionary solutions of maintaining photosynthesis with stomata partially or completely closed on hot, dry days? Your response must have the following terms: **CO2, mesophyll cells, bundle-sheath cells, Calvin Cycle, PEP Carboxylase.** Hint: Identify a C4 and CAM plant then use them in your description.
- **Identify** two biomes that C4 plants dominate and **describe** why?

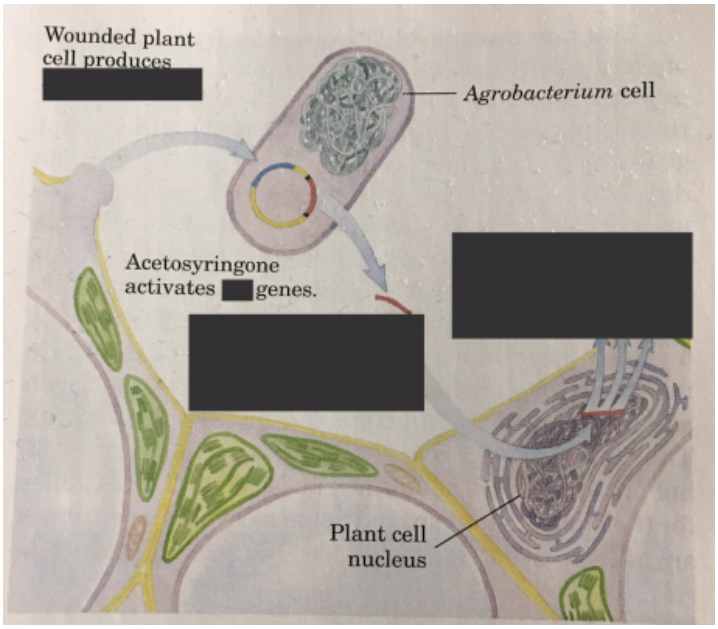
A Bacterial Plant Parasite Aids Cloning In Plants

Plant Genetics and Disease

Researchers are looking into an important and adaptable ally, *Agrobacterium tumefaciens*, because of its ability to invade plants at wounded sites, then transform nearby plant cell chromosomes to synthesize plant hormones for bacterial growth and nutrition. Research can unlock enormous agricultural implications that give alternative possibilities to nutrition and resistance to environmental stresses (e.g, insects, diseases, cold, drought). The following questions will test your knowledge of plant genetics and diseases.

- Here are some supplementary images!





90. (17.00 pts)

Agrobacterium Engineering Is The Future

- Carefully read the following statements regarding *Agrobacterium* in plant transformation to answer the first short answer question:

> 1. Region A in Ti Plasmid is responsible for replication.
> 2. Region D in Ti Plasmid is responsible for virulence.
> 3. A. tumefaciens causes hairy root disease and A. rhizogenes cause crown gall disease.
> 4. Oncogenic (onc) region in T-DNA is responsible for unusual amino acid synthesis.

- **Identify** the correct statement(s) by giving **numeric answer(s).** For example, your answer may be 3, or, 1 and 2, or, 2 and 4. **No partial credit!**
- **Identify** what phenolic compound is released by a wounded plant cell.
- **Describe** the DNA transfer to plant cells by bacterial parasites which are the steps in the image provided. Hint: **There are five steps.**
- **More specifically, what** are the five main steps that *vir* proteins take to transfer copies of Agro T-DNA into a plant's chromosome? **Describe** two.
- **Identify** three types of metabolites converted for the bacterium from plant metabolites through enzymes?

91. (2.00 pts)

Some opines cannot be metabolized by most soil bacteria. Agrobacterium tumefaciens strains have specialized in utilizing these opines. Normally, a particular opine can be catabolized only by that bacterial strain which has induced its synthesis in the plant. Therefore, the wounded plants are forced to produce a special nutrient that can be consumed only by the corresponding *Agrobacterium*. What two components together synthesize opines?

Plant Horticulture

The Importance of Pruning

> Trees continue to survive in spite of the many challenges they face in the urban environment. However, to grow from seedling to a mature tree in the urban forest, they need our help. They are the largest, oldest living organism on the planet and can live long, healthy lives with some assistance. We often place trees in less-than-favorable growing locations that don't allow natural development and maturity and often require pruning to develop a durable structure, improve clearance, and maintain aesthetics. (Lindesy Purcell- Purdue University, Forestry and Natural Resources)

Each cut has the potential to change a tree forever! Learning to properly cut takes time and experience, gaining knowledge from others, and embracing your own successes and failures. Every different specifies has its own particular requirements, and personal judgment plays a huge role. The following questions will test your knowledge of pruning, its techniques, and pathological effects associated with plant arboriculture.

92. (6.00 pts)

Tree Pruning Essentials: Figure 1

- **Name** the pruning technique attempted on this tree.
- **Describe** why this is poor pruning. Do consider the environment.
- **Predict** two potential issues with this tree's health and provide at least one solution.

93. (1.00 pts) Which of the following values is the correct pruning dose (maximum % of total foliage removed at one pruning) for a **mature** tree?

- A) 25%
- B) 10%
- C) 50%
- D) None of the above

94. (1.00 pts) Which of the following horticultural practices is demonstrated in this image showing leaves artfully trimmed into a group of musicians?

- A) Pleaching
- B) Bedding
- C) Mulching
- D) Topiary

95. (1.00 pts) Insects cannot harbor in trees that were poorly mulched.

- True
- False

96. (7.00 pts)

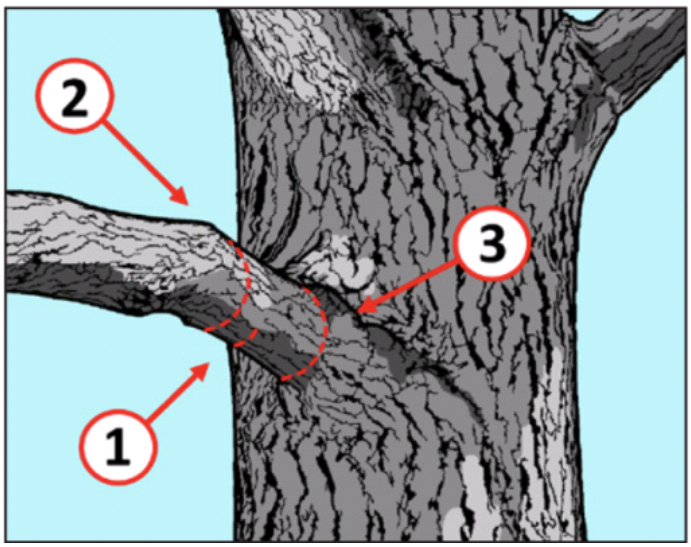
Tree Pruning Essentials: Figure 2

- **Describe** this tree's branches relative to its trunk and a potential risk created during a storm.
- **What** branch aspect ratio (percentage) should be maintained for such tree branches relative to the trunk? Not looking for an exact percentage. Think conceptually.
- **Strategize** how would you prune this tree to create a branch structure that is both sustainable and environmentally safe.

97. (2.00 pts) In terms of the process and practices behind tree installation, which of the following is of poor detail?

A) Establish support systems for your trees by stalking them for no longer than one year.
B) Wrap smooth bark trees as an easy control method to protect trees against rabbits, frost cracks, and sunscalds.
C) Nourish your trees by applying suitable mulching material around the tree.
D) Eliminate tree problems by pruning dead or dying twigs and branches.

98. (3.00 pts)
Arborists refer to the following image as a three-cut method that helps prevent infection by not tearing or splitting of the bark. Identify the three cuts in order from 1 to 3. **Capitalize** the first letter of each word. Do **not** include any spaces in your answers.



99. (9.00 pts)

Pharmacognosy

Understanding drug adulteration

Crude drugs are adulterated by many manufacturers and suppliers to meet high consumer demand and or to gain profit. Read the following quote on how a greenish-brown ayurvedic powdered formulation, *Shatavaryadi Churna*, was used to understand drug adulteration, then answer the subsequent questions:

> Validated modified lycopodium spore method has been developed for simple and rapid quantification of herbal powdered drugs. [It] was performed on ingredients of Shatavaryadi churna, an ayurvedic formulation used as immunomodulator, galactagogue, aphrodisiac and rejuvenator. The method is simple, precise, sensitive, and accurate, and can be used for routine standardisation of raw materials of herbal drugs. Estimation of diagnostic characters of each ingredient of Shatavaryadi churna individually was carried out. Microscopic determination, counting of identifying number, measurement of area, length and breadth of identifying characters were performed using Leica DMLS-2 microscope. This method gives the ratio of individual ingredients in the powdered drug so that any adulteration of genuine drug with its adulterant can be found out. The method shows very good linearity value between 0.988–0.999 for number of identifying character and area of identifying character. Percentage purity of the sample drug can be determined by using the linear equation of standard genuine drug.

Below are supplementary microscopic images:

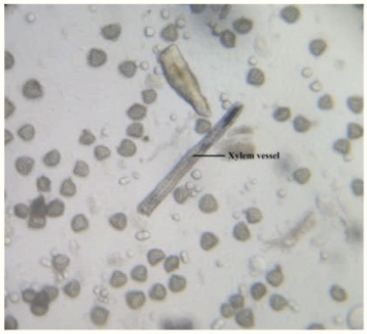


Figure 5

Xylem vessel of *Chlorophytum tuberosum* Baker.

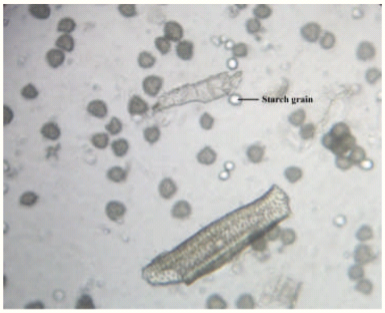


Figure 1

Starch grains of *Asparagus racemosus* Willd. Tuber.

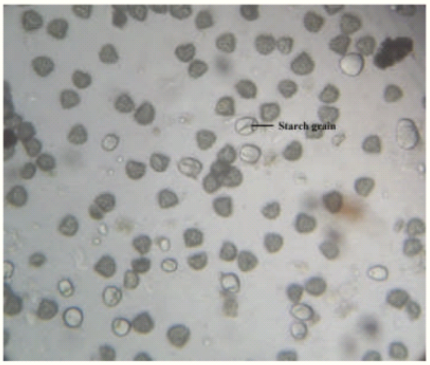


Figure 3

Starch grains of *Mucuna pruriens* Linn. Seed.

- **Define** drug adulteration**.**
- **Name** the adulteration condition.
- **Describe** two other types of drug adulteration **with** at least one example for each type.
- **Give** two reasons for drug adulteration besides economic reasons.

100. (4.00 pts)

The following **tie-breaker** question is in continuation of the preceding passage. Based on the reading, we know that powder supposedly contains many benefits. But do you ever wonder about the manufacturing process?

> One parameter behind the manufacturing process is measuring the percentage of acid-insoluble ash (AIA) in crude drugs. This is performed to detect for any calcium oxalate crystals and several other anomalies. First, 25 mL of diluted HCl is added to a crucible containing the total ash. The diluted contents are then filtered into a beaker so that the filter paper can capture the insoluble matter. Multiple hot-water washes are done. The insoluble matter on the filter paper is folded and placed into the crucible. The crucible is heated in a furnace for an hour at about 600°C. The overall residue with the crucible are placed inside a desicator for 30 minutes.

- **Describe** one other manufacturing process for this herbal drug. Be sure to clearly **identify** your physicochemical parameter.

101. (17.00 pts)

Plant Biochemistry

Shikimic Acid Pathway

Shikimic acid, a Group 3 carcinogen, was named after Johan Frederik Eykman who isolated the toxic Japanese *shikimi* (*Illicium anistum)* flower in 1885. Its secondary metabolites (phenolic compounds) are sources of several interesting compounds useful to chemical, food, and cosmetics. This biochemical pathway consists of seven sequential enzymatic steps that occur in plants, fungi, and bacteria, but **not** in humans and animals. However, the amino acids produced are essential to humans and animals through dietary consumption. It's also used as a starting material by pharmaceutical factories making an anti-viral drug called oseltamivir (Tamiflu), used to treat the swine flu, bird flu, and the regular winter flu.

- **Identify** two **chorismic** biosynthetic precursors.
- **Describe** one distinct pathway (in plants). **Use** specific compound(s) and terms when answering these questions.
- **Identify** two foods containing phenylalanine.
- **Describe** the role of the Shikimic acid pathway in **quercetin** biosynthesis, an effective antioxidant. **Use** specific compound(s) when answering these questions.
- **What** is the difference between *Roundup* versus *Roundup* Ready? **What** enzymatic modification was made to *Roundup*? **Hint**: About an enzyme (one of seven).
- **Describe** the effect on crops and weeds sprayed with *Roundup* in regard to the enzymatic modification?

- **Congratulations, you have finished the botany examination.**
- **Feel free to fill out this test feedback survey: tinyurl.com/RateMySciolyTests.**
- **Interested in Science Olympiad-related classes? Email me, mayurchhitu@gmail.com, for more information and be sure to check out: https://sciovirtual.org/registration.**