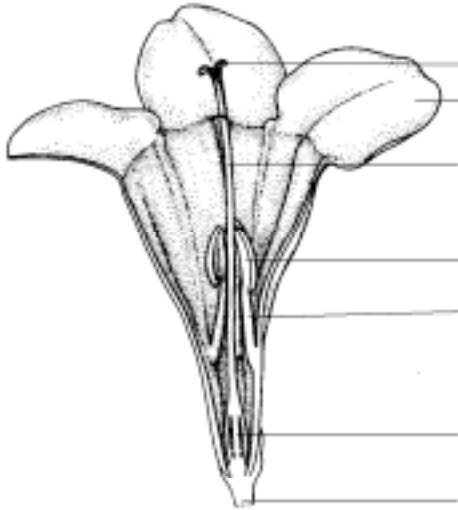
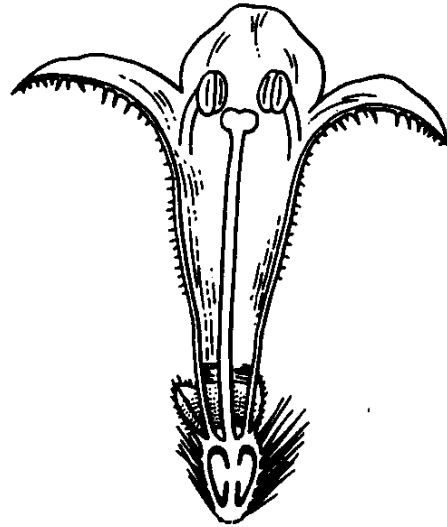


Name _____ **KEY** _____

Be sure to read each question carefully and answer completely. Answers must be **legible** to receive any credit.



Flower A



Flower B

Use diagram A of a floral cross section above to answer the following questions (3 points each):

1. What is the name of the part labeled a? **stigma**
2. What is the collective term for the parts labeled a, c and d? **Pistil**
3. Which is the structure within which seeds develop? **ovary or f**

4. Could this flower come from a dioecious species AND how can you tell?

It cannot be dioecious because the flower has both male and female parts

5. Of the two flowers diagrammed, which do you think is more likely to be outcrossed (answer A or B) AND why?

A is more likely to be outcrossed because the anthers and stigma are farther apart than in B

Definitions (4 points each)

Define each of the following **as used in class or in the text**. Be brief but **complete**. REMEMBER never to use the word itself in the definition and not to give an example rather than a definition.

6. Pollen vector – *a mobile agent that moves male plant gametes (pollen) from anther to stigma*

7. Plagiarism - *the use of another's ideas or words (or close paraphrasing of another's words) without acknowledgement of the source.*

8. Student's t-test - *statistical test used to compare the mean of a variable between two groups*

9. Outcrossing – *the fertilization of the ovules of one plant by pollen produced by a different plant (not a different "flower").*

10. Null Hypothesis (remember don't use part of the word in the definition). – *a proposed explanation that posits no effect or no difference between groups*

Short answer (5 pt each)

11. What is the difference between inbreeding and inbreeding depression?
Inbreeding is mating between close relatives and inbreeding depression is the reduction of fitness of inbred vs outcrossed offspring

12. What is the difference between an observational test of an hypothesis and an experimental test? *An observational test compares groups that differ naturally in some aspect and an experimental test compares groups that have been manipulated to be different.*

13. While walking home late one evening, you discover a new species of flowering plant. It has medium-sized, white, tubular flowers and it produces a sweet, fruity scent. On your way to school the next afternoon, you notice that the flowers are closed. Describe specific floral characteristics of this plant that could allow you to eliminate each of two biotic pollen vectors as likely pollinators for this species. (For example, it doesn't flower in the ocean, so you can probably eliminate whales).

Any two:

Open at night – eliminates birds, butterflies

Sweet scent – eliminates flies and bats

White color – eliminates hummingbirds

14. What is the primary difference between ordinal and nominal data?

Ordinal data can be ordered quantitatively and nominal data are named categories that have no quantitative relationship to each other.

15. What two aspects of a foraging behavior must be measured to quantify its efficiency AND describe the effect of each one on efficiency?

The costs and benefits of a behavior must be measured to determine its efficiency. Increasing costs decreases efficiency and increasing benefits increases efficiency

Experimental Scenarios

16. In a field of poppies you notice that some flowers have blue anthers and others have yellow anthers, which causes you to wonder whether different pollinators might visit these two kinds of flowers. There are birds, bees, and beetles foraging on poppies in the field and you want to know if the frequencies of visits from the three types of pollinators differ between the two flower types (4 pt for each part)

a. State appropriate null and alternative hypothesis for your question?

H₀: The frequencies of visits from different pollinator types will not differ between flowers with blue and yellow anthers

H_a: There will be a difference between flowers with blue and yellow anthers in the frequencies of visits by different pollinator types.

b. What two variables will you record to test your hypothesis and for each one, is this nominal or ordinal data?

Pollinator type, which is nominal
Number of visits, which is ordinal

c. What statistical procedure will you use to analyze your data and test your hypothesis? (Be sure to say what variable you are comparing and what groups are being compared). *Use a Chi-square contingency test to determine if the frequencies of visits by different types of pollinators depend on anther color.*

d. If the critical value for your test statistic at the appropriate degrees of freedom is 12, and the value you calculate from your observed data is 16, what conclusion should you draw with respect to your hypotheses?

Reject the null hypothesis

17. A pollination biologist observing insects visiting flowers in a meadow wishes to determine if the presence of pollen helps to attract pollinating bees. To test his hypothesis, he chooses one purple flower and one white flower to observe. He removes all of the pollen from the purple flower and leaves the pollen in the white flower intact. He then counts the number of bees that visit each flower in a six hour period and proposes to use a t-test to compare the mean number of visits by bees to the flower with the pollen removed to the mean for the flower with the pollen left intact.

a. There are at least two problems with the design of this study that will prevent a valid test of the biologist's hypothesis. Briefly identify two of these problems (6 pt). (If you're stuck, look for each of the essential elements of an experiment).

Any two:

Flower color is confounded with the treatment

There is no replication

You cannot calculate a mean and variance from one number, so a t-test is not possible.

b. For each problem you identified in part a, describe how the biologist could either avoid or fix the problem (6 pt).

Any two

Use only one flower color

Increase replication by using many flowers, or use both but randomly assign treatments to flower colors

Use a Chi-square goodness of fit test to analyze the data, or make observations over multiple time periods and use a t-test

18. A TA for Experimental Biology hypothesizes that radish flowers at the Mission Road Research Station are more likely to be pollinated if they are marked with blue flags than if they are marked with red flags. The TA marks 20 plants with red flags and 20 with blue flags and after two weeks, counts the number of flowers that set seed on each plant (2 points each).

a. What constitutes the **population** that the biologist is interested in?

The radish flowers at Mission Road Research Station

b. What constitutes a **sample** in this study?

The flowers marked with flags

c. Name a **variable** that will be measured.

Number of flowers that set seed (flag color is a treatment, not a variable)

d. Is this variable ordinal or nominal and is it discrete or continuous?

Ordinal and discrete