

Introduction to Natural Science 2007  
Biology Exam I

ANSWER KEY

1. Match a single term on the left with the best description on the right. Write your answer in the blank space.

A. gametes	___ C ___	similar morphological traits
B. fitness	___ G ___	joins sister chromatids
C. structural homologies	___ E ___	is diploid
D. hypothesis	___ H ___	synapsed homologous chromosomes
E. zygote	___ B ___	measured in units of # of offspring
F. natural selection	___ I ___	different versions of the same gene
G. centromere	___ D ___	can be rejected or supported
H. tetrad	___ A ___	produced from meiosis
I. allele	___ J ___	hereditary determinant for a trait
J. gene	___ F ___	acts on individuals

2. (A) In humans, the presence of a Widow's peak (W) and the ability to roll the tongue (T) are dominant to the lack of a Widow's peak (w) and the inability to roll the tongue (t). What is the probability that a mother, who is heterozygous for both these traits, and a father, who is heterozygous for Widow's peak but cannot roll his tongue, will have a child who lacks a Widow's peak and is a tongue roller? (Show your work and circle your answer.)

Mother: WwTt      X      Father: Wwtt

P(child: wwTt)? Note: The child must be wwTt because only the mother can give the dominant allele.

$$P(ww) = 1/4$$

$$P(Tt) = 1/2$$

$$P(ww \text{ and } Tt) = P(ww) * P(Tt) = (1/4)(1/2) = 1/8$$

(B) What is the probability that this same child will be a boy? (Show your work and circle your answer.)

**P(boy) = (1/2); the probability of being a boy is independent from lacking a widow's peak and being a tongue roller. However, I understand that this question could be misinterpreted so I gave credit for either this answer or the following one:**

$$P(wwTt \text{ and } \text{boy}) = P(wwTt) * P(\text{boy}) = (1/8)(1/2) = 1/16$$

3. In tigers, a recessive allele causes an absence of fur pigmentation (a "white tiger") and a cross-eyed condition. If two phenotypically normal tigers that are heterozygous at this locus were mated, what percentage of their offspring will be cross-eyed? What percentage will be white? (Explain your reasoning.)

**Setting up a Punnet square of Ww crossed with a Ww will reveal that a ww (crossed eyed, white tiger) will be one fourth, or 25%, of the offspring. Because the same allele causes both traits, the percentage of offspring with the recessive trait is the same.**

4. A diploid organism has the genotype AaBB with allele pairs on different chromosome pairs. Indicate whether each drawing represents a cell in anaphase of: mitosis, meiosis I, meiosis II, or none of these (it is not possible for this organism; assume that there are no genetic abnormalities). For each drawing, briefly describe why you selected your answer, particularly if you selected “none of these”.

Representational Schematic of Anaphase	Represents anaphase of?	Support your answer here:
	None of these	The genotype of the organism is AaBB, so it is not possible for the organism to have a recessive “b” allele.
	None of these	Although this looks like meiosis II, it is not because the homologous chromosomes would be in separate cells. This diagram shows both homologs in the same cell without the B homologs.
	Meiosis II	The sister chromatids are separating. These chromosomes have already separated from their homologs (a and B in this case).
	None of these	Although this looks like mitosis because the chromosomes are all lined up and sister chromatids are separating, there are two sets of the same chromosomes (AA + aa) and the BB homologs are missing.
	Meiosis I	The homologous chromosomes are moving towards opposite poles as they should. How one set of homologs (Aa) assorted is independent of the other homologs (BB) assorted.
	None of these	All of the chromosomes are lined up and the sister chromatids are separating, but there is a recessive “b” allele and the genotype of the organism is AaBB.

5. The F1 generation of a testcross between a pea plant with round, yellow seeds (both dominant traits) and a homozygous recessive plant for these traits are of two phenotypic types: half have round, yellow seeds, and half have wrinkled, yellow seeds (i.e. all are yellow, 1/2 are round, and 1/2 are wrinkled.) What is the **genotype** of the round, yellow parent? (Circle your answer.)

RrYY

Work backwards to figure this one out; try using a Punnett square.

6. A cell from an organism with a haploid number of 3 undergoes meiosis. Draw the one phase in meiosis that best illustrates Mendel's Principle of Independent Assortment. Be sure to clearly label your drawing.

**The phase that best illustrates Independent Assortment would be metaphase I of Meiosis I because that is when the homologs independently line up at the metaphase plate. If you put down Anaphase I then that would be ok as well. Two points for that, two points for the correct number of chromosomes, and two points for proper labels.**

7. Explain the ways in which fertilization and meiosis lead to genetic variation.

Fertilization occurs between two haploid cells with different allele combinations. By combining their haploid genomes, they create a cell with a new combination of alleles.

**Meiosis leads to variation in two ways: first, the homologous chromosomes can independently assort, leading to different combinations of alleles, and two, the homologous chromosomes can independently assort, leading to different combinations of alleles**

8. Describe at least two pieces of evidence that Darwin put forward to support his hypothesis that species are modified or change through time.

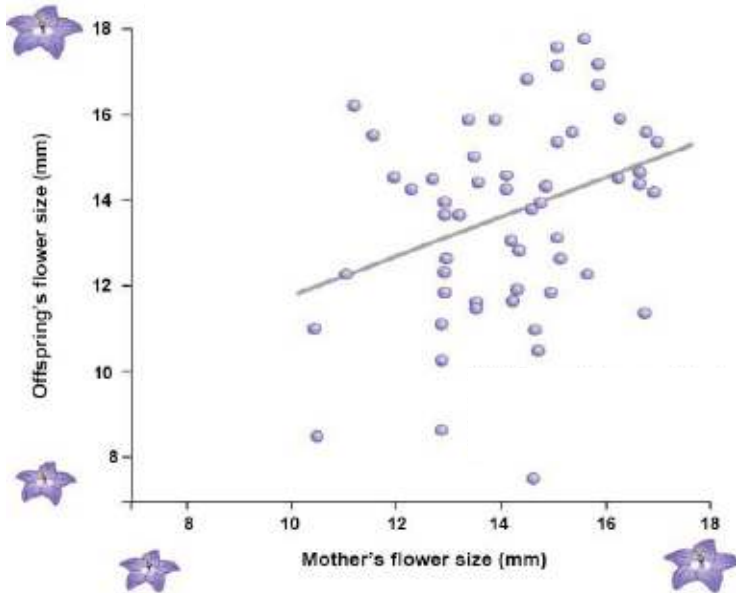
**I accepted many answers that were evidence that Darwin put forward. I did not give credit for supporting evidence provided by scientists other than Darwin. Full credit was given to those who described the evidence, not just listed it. Some examples included fossil evidence, vestigial traits, structural homologies, etc... there is a list in the book.**

9. Researcher Candace Galen made the following observations about alpine skypilots (flowers):

- a. Above the treeline bees are main pollinator of skypilots and flowers are large
- b. Below the treeline flies are main pollinator of skypilots and the flowers are small

She hypothesized that: Pollinator preferences for different sized flowers lead to observed differences in flower size in these populations. **For each graph (A and B), state which of Darwin's Postulates is/are being tested in the experiment. Explain your reasoning.**

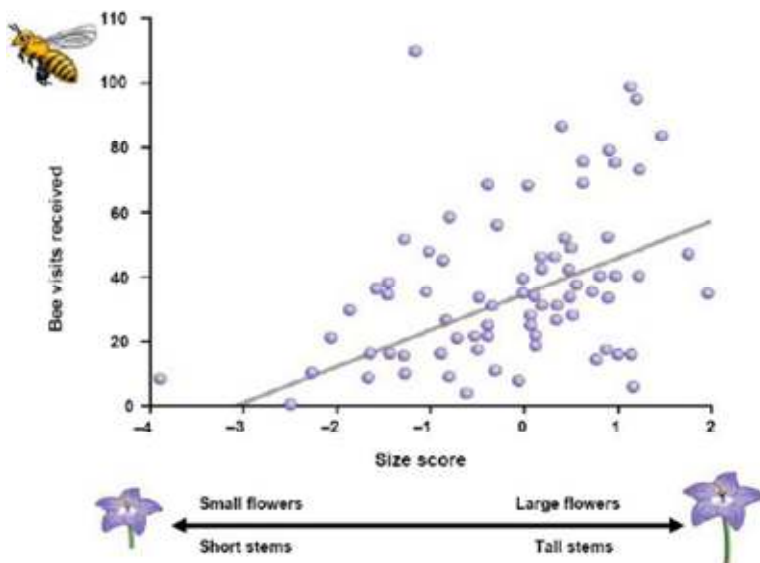
**Graph A (Respond in the space below)**



The graph shows that a) traits vary within a population, and b) that traits are variable.

Mothers with large flowers produce offspring with large flowers. Mothers with small flowers tend to produce offspring with small flowers.

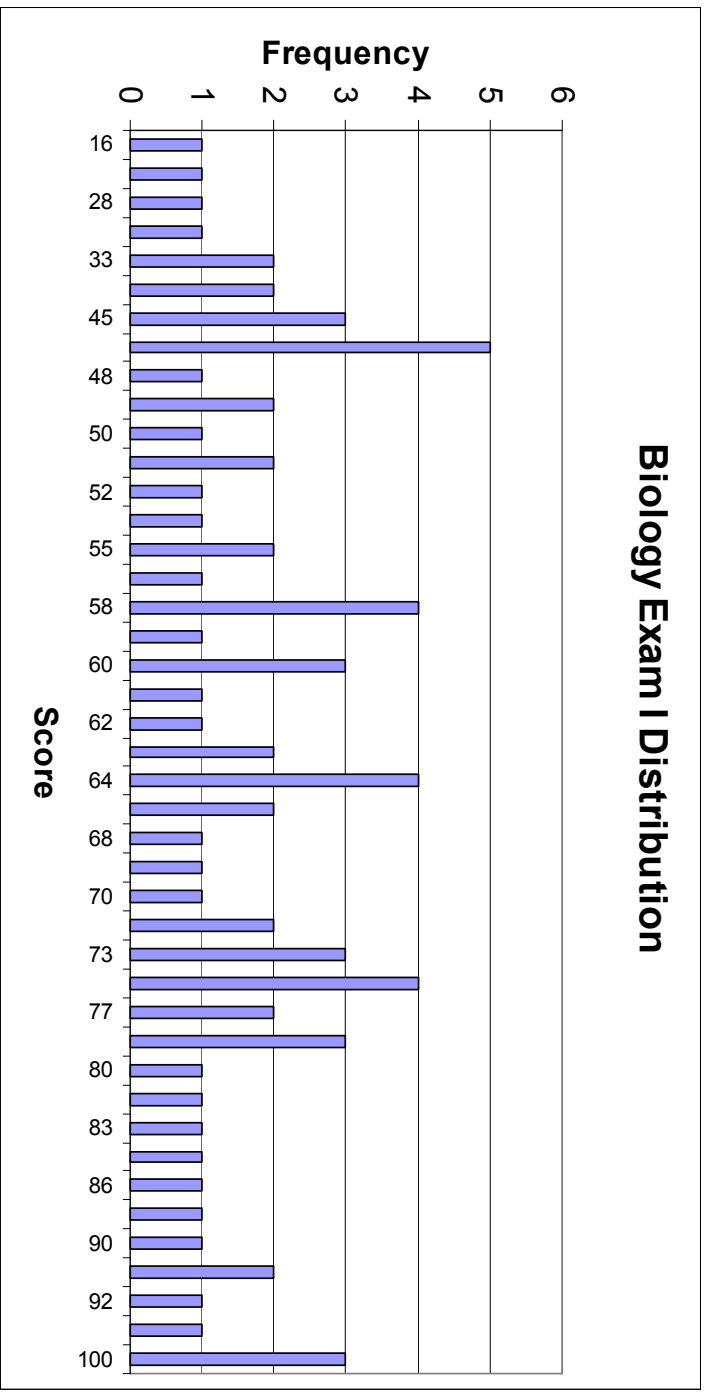
**Graph B (Respond in the space below)**



This graph shows that a trait is being selected for within a population. Anything along these lines would get you credit as long as it was clear.

Large flowers receive more bees visits so the large flower trait is being selected for within this population. Bees pollinate the flowers so those flowers that receive visits will go on to produce offspring.

# Biology Exam I Distribution



Mean: 64