

## THE GENETICS DIAGNOSTIC QUESTION CLUSTER

### DQC Group – Michigan State University

Questions are categorized according to the practices demanded by the stem. Correct answers are indicated in green. Some questions have alternative stems that can be used with the same foils.

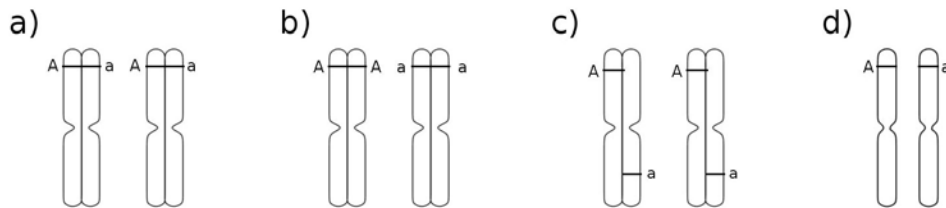
#### *Keeping track of matter/chromosomes and information*

##### 1. Connecting Punnett squares, meiosis, and fertilization – multiple choice

Below is a Punnett square of a standard monohybrid (one gene) cross. There are two forms of the gene, A and a.

	A	a
A		
a		

- Which figure (a, **b**, c, d) best represented metaphase I, when the chromosomes are lined up for the first division?
- Which figure (a, b, c, **d**) could go in one of the blank squares in the Punnett square?



##### 2. Connecting Punnett squares, meiosis, and fertilization – open-ended

You are breeding cats, one that is homozygous recessive (dd) for the characteristic *dilute* and the other is heterozygous for the same characteristic.

- Set up a Punnett square for this cross.
- What are the probabilities of each genotype (DD; Dd; dd) among the progeny?
- The circles below represent a gamete produced by each parent cat. Draw the chromosomes and alleles in the gametes.



### Scoring

- Students' representations of chromosomes in alleles (chromosome number, unreplicated vs replicated)
- Students' representations of alleles in gametes
- Students' representation of genotypes in Punnett square.

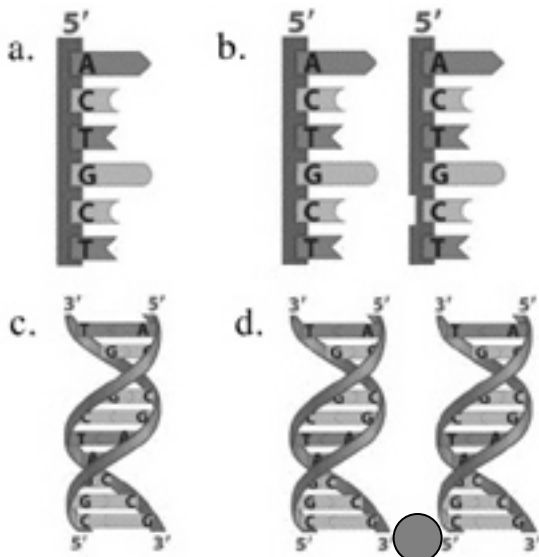
Note: In this question and the previous one, we are not concerned about students knowing at what stages chromosomes are condensed.

*Version 2.* Suppose you are working with a diploid organism that has four chromosomes. In the circle, draw how the chromosomes would look in meiosis I.

### ***Keeping track of matter/ DNA***

#### **3. Double, double, double**

This is a diagram [standard picture of recently divided cell] of a cell that has recently completed cell division]. Which diagram below (a, b, c, d) represents the DNA in this cell?



### ***Keeping track of information***

#### **4. Dominant vs recessive – incomplete dominance**

Purple hollyhocks (PP) crossed with white hollyhocks (pp) produce lavender hollyhocks. Lavender hollyhocks are due to:

- A. The P allele no longer being dominant.
- B. The P gene product losing dominance.
- C. The DNA of the P and p alleles combining.
- D. The P and p gene products combining.

[Essay format – Describe the interactions between: a) the genes and b) the proteins in a heterozygous (Pp) plant.]

#### 5. Dominant vs recessive - clicker question to stimulate discussion

In a standard monohybrid cross, one phenotype is shown by BB and Bb individuals and other phenotype is seen in the bb individuals. This means that:

- A. The B allele prevents the expression of the b allele.
- B. The B allele codes for the normal phenotype; the b alleles codes for a mutant phenotype.
- C. The proteins coded by the B allele mask the expression of the proteins coded by the b allele.
- D. Both the B and b alleles encode active gene products.

[Essay format – Describe the interactions between: a) the genes and b) the proteins in a heterozygous (Bb) individual.]

#### 6. Dominant vs recessive – exam multiple choice

In cats, the D gene determines the darkness of a cat. “DD” and “Dd” have full color and “dd” cats have pale color. Which of the following is true in a Dd individual?

- A. Only the dominant (D) allele is transcribed.
- B. Because D is dominant over d, only the D protein will be produced.
- C. Both alleles are transcribed and translated.
- D. Only the D allele makes a functional protein.

[Essay format – Describe the interactions between: a) the genes and b) the proteins in a heterozygous (Dd) cat.]

#### 7. Dominant vs recessive – Mendelian genetics

If you breed a pale yellow squash (YY) with a green squash (yy), you only get pale yellow squashes (Yy) in the first generation of offspring. Interbreeding these offspring (Yy) produces both yellow and green squashes in the second generation. How/why are these two different colors of squash produced in this pattern?

- A. The Y allele takes over the y allele in the first generation.
- B. The protein coded by the Y allele does not prevent production of green pigment.**
- C. The proteins are coded only by the dominant Y allele.
- D. The y allele is recessive in the first generation but dominant in the second generation.