# Genetics Final Quiz: Part B

**This packet includes a "NewWorm" Quiz.**

## DIRECTIONS

1. **Write your name on EVERY page.**
2. **Use a pen. To change an answer, cross it out.**
3. **Use empty spaces on the test for any scratch work. DO NOT use scratch paper or the backs of pages.**
4. **If you are worried about time, skip the parts where you are asked to explain your answers, and do them last.**
5. **Do your best.**

**The NewWorm©**



## MONOHYBRID INHERITANCE II: TEXTURE

(effect to cause; autosomal simple dominance)

Another inherited characteristic in the NewWorm is Texture. Both NewWorm1 and NewWorm2 have wrinkled skin. However when you mate them and produce 100 offspring, you find:

- 78 (38 males and 40 females) have wrinkled skin
- 22 (11 males and 11 females) have smooth skin

**Remember**: Males are XX and females are XY.

1. There are two alleles for Texture. Is the relationship between the two alleles simple dominance or incomplete dominance?

   Answer: **simple**

   1a. What is it about the **offspring** that indicates simple or incomplete dominance?

   **A.** **two offspring phenotypes**
   **A=2 pts.**
   **OR no intermediate phenotype** **B=1 pt.**
   **BLANK**
   **B.** **SS=Ss**

2. **If** one of the Texture alleles is dominant, which one is it (wrinkled, smooth, OR neither)?

   Answer: **wrinkled**

   2a. What is it about the **offspring data** that shows you which, if any, allele is dominant?

   **Data argument** **any argument**
   **A.3:1 ratio (wrinkled:smooth)** **A=2 pts.**

   **B.** **"more" wrinkled B=1 pt.**
   **# wrinkled vs. # smooth**
   **BLANK**

   **Inheritance argument**
   **A. wrinkled parents carry recessive smooth allele; smooth offspring display recessive phenotype (some genetic explanation in answer)**

   **B. neither parent has smooth skin but some offspring have smooth skin**

   **Inheritance "Counter"-argument**
   **A. if wrinkled was recessive OR smooth was dominant, then all offspring would be wrinkled because parents would have only recessive alleles (some genetic explanation in answer)**

   **B. if wrinkled was recessive OR smooth was dominant, then all offspring would be wrinkled**

3. Is the gene for Texture autosomal or X-linked?

   Answer: **autosomal**

   3a. What is it about the **offspring data** that indicates whether the gene is autosomal or X-linked?

   **A.50% male:50% female** **A+B=2 pts.**
   **B.** **of each phenotype** **A or B=1 pt.**
   **OR**

**C.**
**C=2 pt.**

**nothing missing in the males**

**BLANK**

## MONOHYBRID INHERITANCE II: EYELIDS

(effect to cause; X-linked simple dominance)

Another inherited characteristic in the NewWorm is Eyelids. Both NewWorm1 and NewWorm2 have clear eyelids. However when you mate them and produce 100 offspring, you find:

- 74 (51 males and 23 females) have clear eyelids
- 26 (0 males and 26 females) have cloudy eyelids

**Remember**: Males are XX and females are XY.

1. There are two alleles for Eyelids. Is the relationship between the two alleles simple dominance or incomplete dominance?

   Answer: **simple**

   1a. What is it about the **offspring** that indicates simple or incomplete dominance?

   **A.** **two offspring phenotypes**
   **A=2 pts.**
   **OR no intermediate phenotype** **B=1 pt.**
   **BLANK**
   **B.** **CC=Cc**

2. **If** one of the Eyelids alleles is dominant, which one is it (clear, cloudy, OR neither)?

   Answer: **clear**

   2a. What is it about the **offspring data** that shows you which, if any, allele is dominant?

   **Data argument** **any argument**
   **A.3:1 ratio (clear:cloudy)** **A=2 pts.**

   **B.** **"more" clear** **B=1 pt.**

   **BLANK**

   **Inheritance argument**
   **A. hidden OR recessive cloudy allele shows in $^1/_2$ female offspring (some genetic explanation in answer)**

   **B. neither parent has cloudy eyelids but some offspring have cloudy eyelids**

   **Inheritance "Counter"-argument**
   **A. if clear was recessive OR cloudy was dominant, then all offspring would be clear because parents would have only recessive alleles (some genetic explanation in answer)**

   **B. if clear was recessive OR cloudy was dominant, then all offspring would be clear**

3. Is the gene for Eyelids autosomal or X-linked?

   Answer: **X-linked**

   3a. What is it about the **offspring data** that indicates whether the gene is autosomal or X-linked?

   **A.** **phenotypic class with no**
   **males OR only females** **A=2 pts.**

**B.**
**and females**

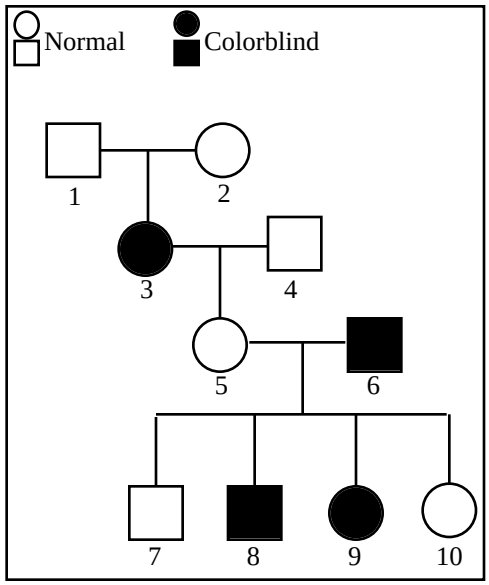
**different numbers of males**
**B=1 pt.**

## PEDIGREE II: COLOR VISION–AUTOSOMAL OR X-LINKED?

(effect to cause; autosomal simple dominance)

Consider another NewWorm characteristic–Color Vision.

- Color Vision has two phenotypes as shown with the pedigree.
- Females are represented by circles and males are represented by squares.
- **Remember**: Males are XX and females are XY.
- Decide if the pedigree is consistent with Color Vision being autosomal or X-linked.




1. Does the Color Vision gene **appear** to be autosomal or X-linked?

   Answer: **autosomal**

   1a. Using words and/or diagrams, explain your answer (use the numbers below each circle or square to refer to particular individuals).

   **A.**
   **recessive (1, 2, 3 pattern OR 3, 5, 8/9 pattern shows colorblindness skipping generations), therefore 3 is homozygous recessive (if autosomal) or hemizygous recessive (if X-linked).**

   **Colorblindness is A+B=2 pts. A or B =1 pt. BLANK**

   **B. (1) If X-linked, 5 is hemizygous dominant (C-) and 6 is homozygous recessive (cc) in which case all their sons would have normal vision (Cc) and all their daughters would be colorblind (c-). 8 is a colorblind son and 10 is a normal-color-vision daughter which rules out X-linkage. (2) If autosomal, 5 is heterozygous (Cc) and 6 is homozygous recessive (cc) in which case sons or daughters could be colorblind or have normal color vision. 7-10 show all possible combinations of sex and color vision status so pedigree is consistent with autosomal inheritance.**

2. Does this pedigree rule out the type of inheritance you did not choose?

   Answer: **yes**

   2a. Using words and/or diagrams, explain your answer (use the numbers below each circle or square to refer to particular individuals).

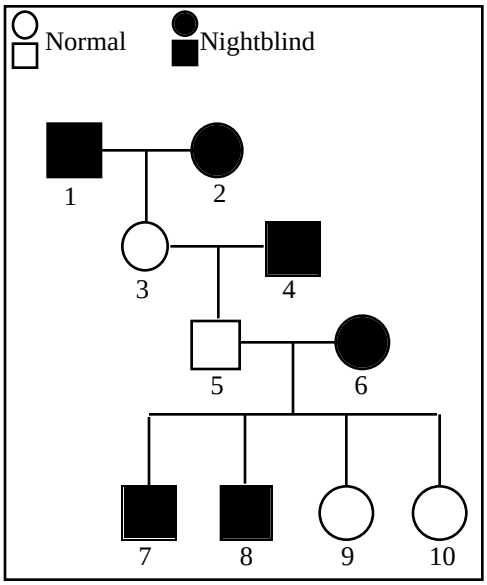
   **B(1) in 1a.=2 pts.**

## PEDIGREE II: NIGHT VISION–AUTOSOMAL OR X-LINKED?

(effect to cause; X-linked simple dominance)

Consider another NewWorm characteristic–Night Vision.

- Night Vision has two phenotypes as shown with the pedigree.
- Females are represented by circles and males are represented by squares.
- **Remember**: Males are XX and females are XY.
- Decide if the pedigree is consistent with Night Vision being autosomal or X-linked.




1. Does the Night Vision gene **appear** to be autosomal or X-linked?

   Answer: **X-linked**

   1a. Using words and/or diagrams, explain your answer (use the numbers below each circle or square to refer to particular individuals).

   **A.**
   **dominant (1, 2, 3 pattern where one or both parents contribute hidden recessive allele to 3, making 3 homozygous recessive. Therefore 6 is either hemizygous dominant (if X-linked) or heterozygous (if autosomal).**

   **Nightblindness is A+B=2 pts. A or B =1 pt. BLANK**

   **B. (1) If X-linked, 5 is homozygous recessive (nn) and 6 is hemizygous dominant (N-) in which case all their sons would be nightblind (Nn) and all their daughters would have normal night vision (n-) which is the pattern in the pedigree. Therefore, night vision appears to be X-linked.**

2. Does this pedigree rule out the type of inheritance you did not choose?

   Answer: **no**

   2a. Using words and/or diagrams, explain your answer (use the numbers below each circle or square to refer to particular individuals).

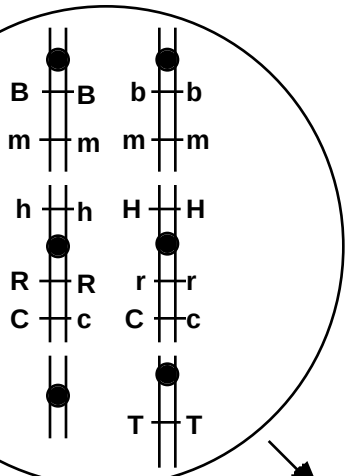
   **The same pattern of inheritance could occur if night vision was autosomal. 1, 2, 4, 6, 7 and 8 could be heterozygous (Nn) and 3, 5, 9 and 10 could be homozygous recessive (nn). (2 pts. max)**

## MEIOSIS: THE PROCESS

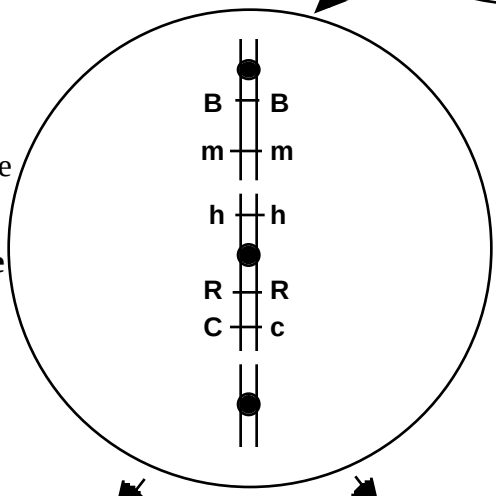
(process reasoning)

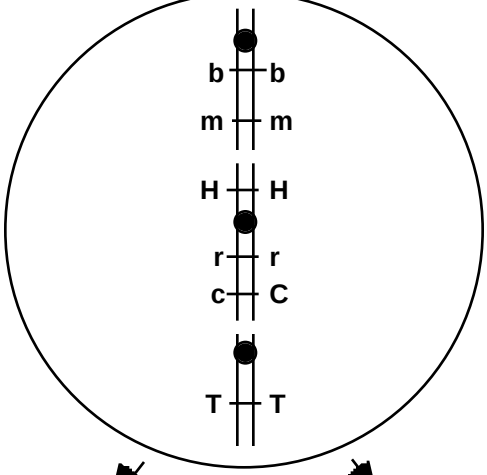
This diagram shows the two divisions of meiosis.

**1**. In this cell, add allele letters to the chromosomes to show how they lined up **just before** the first division that produced the **Gamete Set** below.

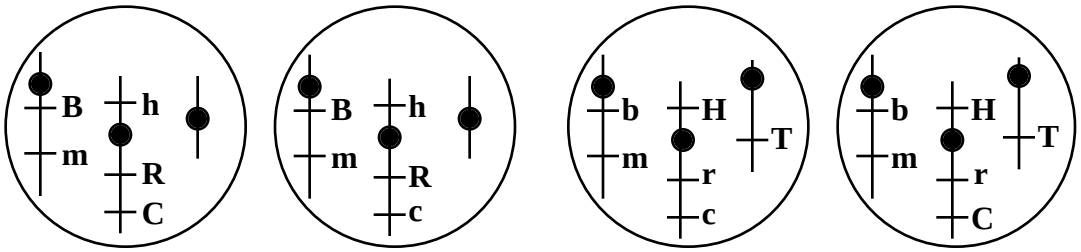



**2**. In these two cells, add allele letters to the chromosomes to show how they lined up **just before** the second division that produced the **Gamete Set** below.



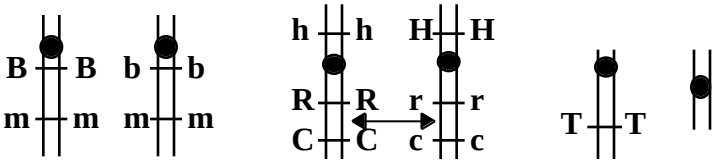




**Gamete Set** →




The diagram to the right shows NewWorm2's chromosomes at the **beginning** of meiosis.

**3**. Use **arrows** on the diagram to the right to show the exact location of any crossovers needed to produce the gamete set above.



# TEACHER KEY

**Scoring Meiosis: The Process (NewWorm)**

If any part of 1 or 2 is done, then give numerical score 1, 1a, 2, and 2a.
If no part of 1 or 2 is done, then score 1, 1a, 2, and 2a as BLANK.

**1** (3 pt max)

- 1 pt. for correct chromosomes
- 1 pt. for paired homologues
- 1 pt. for crossover reflected

**1a** (2 pt max)

- 1 pt. for consistency with one intermediate cell
- 1 pt. for consistency with other intermediate cell

**2** (2 pt max)

- 1 pt. for one of each chromosome in each cell
- 1 pt. for crossover reflected

**2a** (2 pt max)

- 1 pt. for consistency between one intermediate cell and its two final cells
- 1 pt. for consistency between other intermediate cell and its two final cells

**3** (2 pt max)

- 2 pts. if **only** crossover between rings and color genes indicated
- 1 pt. if crossover between rings and color gene indicated **and** other crossovers indicated
- 0 pts. for anything else
- BLANK

| **NewWorm Genetics** | **Two NewWorm Genotypes** |
|---|---|
| **Body:** Flat: **BB** or **Bb** Round: **bb**<br>**Mouth:** Oval: **??** Slit: **??**<br>**Head:** Broad: **??** Medium: **??** Narrow: **??**<br>**Rings**: No Rings: **RR** or **Rr** Rings: **rr**<br>**Color:** Green: **CC** Brown: **Cc** Black: **cc**<br>**Tail (Male):** Pointed: **TT** or **Tt** Blunt: **tt**<br>**Tail (Female):** Pointed: **T–** Blunt: **t–**<br>(The Tail gene is on the **X** chromosome.)<br>(The **–** [dash] stands for the **Y** chromosome.)<br>**Sex:** Males: **XX** Females: **XY** | **NewWorm1** b m / b M; H r c / H r c; T / t<br>**NewWorm2** B m / b m; h R C / H r c; T / |

## PROBABILITY I

In a mating of NewWorm1 and NewWorm2, the chance of getting babies with **rings** is 1/2 or 50%.

1. Draw a Punnett square that shows this. Include genotypes and phenotypes.
(cause to effect, probabilistic reasoning; autosomal simple dominance)

| | **R** | **r** |
|---|---|---|
| **r** | **Rr** | **rr** |

**1/2 rings**

2. Explain and/or draw a diagram that shows how the way that chromosomes line up and separate during meiosis in NewWorm2 contributes to the 1/2 chance of getting worms with rings from this cross.
(process, probabilistic reasoning; autosomal simple dominance)

**2a) correct chromosome model (1 pt.)**

**2b) indicate somehow that paired homologues align in initial cell (1 pt.)**

**2c) indicate somehow that homologous chromosomes separate during the first division (2 pts. max)**

**2d) indicate somehow that chromatids separate during the second division (1 pt.)**

**2e)** **indicate somehow that $^{1}/_{2}$ R gametes and $^{1}/_{2}$ r gametes (1 pt.)**

**NewWorm Genetics**

**Body:** Flat: **BB** or **Bb** Round: **bb**

**Mouth:** Oval: **??** Slit: **??**

**Head:** Broad: **??** Medium: **??** Narrow: **??**

**Rings**: No Rings: **RR** or **Rr** Rings: **rr**

**Color:** Green: **CC** Brown: **Cc** Black: **cc**

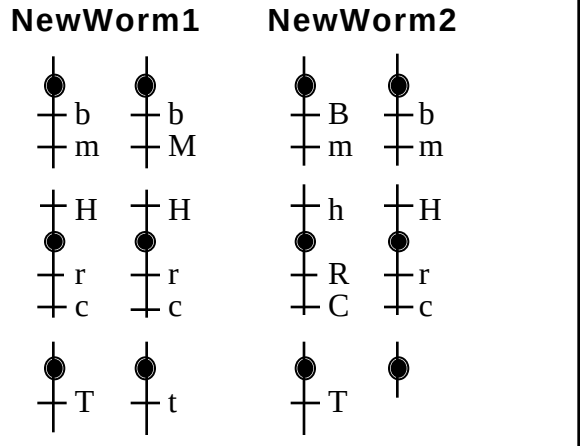
**Tail (Male):** Pointed: **TT** or **Tt** Blunt: **tt**

**Tail (Female):** Pointed: **T–** Blunt: **t–**

(The Tail gene is on the **X** chromosome.)
(The **–** [dash] stands for the **Y** chromosome.)

**Sex:** Males: **XX** Females: **XY**

**Two NewWorm Genotypes**




## PROBABILITY II

In a mating of NewWorm1 and NewWorm2, the chance of getting babies with **round bodies** AND **no rings** is 1/4 or 25%.

1. Draw a Punnett square that shows this. Include genotypes and phenotypes.
(cause to effect, probabilistic reasoning; dihybrid: both autosomal simple dominance)

**Possibility A**

| | BR | Br | bR | br |
|---|---|---|---|---|
| br | BbRr | Bbrr | bbRr | bbrr |

$^1/_4$ round & no rings

**Possibility B**

| | B | b |
|---|---|---|
| b | Bb | bb |

| | R | r |
|---|---|---|
| r | Rr | rr |

$^1/_2$ round $^1/_2$ no rings

($^1/_2$ round) X ($^1/_2$ no rings) =
$^1/_4$ round & no rings

2. Explain and/or draw a diagram that shows how the way that chromosomes line up and separate during meiosis in NewWorm2 contribute to the 1/4 chance of getting worms with round bodies and no rings from this cross. (process, probabilistic reasoning; dihybrid: both autosomal simple dominance)

**2a) correct chromosome model (1 pt.)**

**2b) indicate somehow that paired homologues align in initial cell (1 pt.)**

**2c) indicate somehow that nonhomologous pairs align randomly with respect to each other so that $^1/_2$ the time they align one way and $^1/_2$ the time they align the other way with respect to each other (2 pts. max)**

**2d) indicate somehow that homologous chromosomes separate during the first division (2 pts. max)**

**2e) indicate somehow that chromatids separate during the second division (1 pt.)**

**2f) indicate somehow that $^{1}/_{4}$ of the gametes are bR (1 pt.)**