

# SHOULD THIS DOG BE CALLED SPOT?

Imagine this microscopic drama. A sperm cell from a male dog fuses with an egg cell from a female dog. Each dog's gamete carries 39 chromosomes. The zygote that results from the fusion of the gametes contains 78 chromosomes – one set of 39 chromosomes from each parent. One pair of the zygote's chromosomes is shown below.

Chromosome from the female dog



Chromosome from the male dog



Each chromosome of the homologous pair contains alleles for the same traits. But one chromosome may have a dominant allele and the other may have a recessive allele. Use the drawing above and the table below to answer the questions.

TRAIT	Dominant Gene	Recessive Gene
Hair length	Short (L)	Long (l)
Hair Texture	Wiry (T)	Silky (t)
Hair Curliness	Curly (H)	Straight (h)
Coat Pattern	Spotted (A)	Solid (a)

1. Will the new puppy have a spotted coat? yes Explain why or why not:

The puppy inherited the dominant allele for spots from its father.

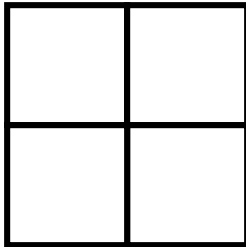
2. Does the female dog (mother) have a spotted coat? not enough info Explain how you know this:

She could have a dominant allele on her other chromosome, which is information we don't have.

3. Does the male dog (dad) have a spotted coat? yes Explain how you know this:

The male has at least one dominant allele that he gave to the puppy so we know that the male is spotted.

4. What will be the **texture** of the puppy's coat?   wiry
5. Will the texture of the puppy's coat resemble that of either of its parents?   yes    
Explain how you know this:   The wiry allele is dominant, and both parents have the dominant allele, which gives them wiry fur
6. Will the puppy have curly hair or straight hair?   Curly
7. a. Does the female dog have curly hair?   Unknown    
b. Does the male dog have curly hair?   Yes
8. a. Define the term **heterozygous**:   Two different alleles    
b. For which traits is the puppy **heterozygous**?   Hair Length, Hair Curliness, Hair Pattern
9. a. Define the term **homozygous**   Two identical alleles    
b. For which traits is the puppy **homozygous**?   Hair Texture
10. Explain why you cannot completely describe the puppy's parents even though you can accurately describe the puppy.   We only have half of the parents' genetic information so we cannot know the phenotype of the parents but we do have the complete genotype of the puppy from the parents and can know phenotype from that



# WHEN IN DOUBT PUNNETT!!

## BIOLOGY 1

In rabbits, the gene for black (B) fur is dominant over the gene for white fur (b). Write the genotype and phenotype for the following table.

	GENOTYPE	PHENOTYPE
Heterozygous	Bb	Black
Homozygous Dominant	BB	Black
Homozygous Recessive	bb	White

1. The pair of letters that represent the genes of an organism is called the genotype.
2. The description of the trait by gene expression (such as black fur or white fur) is called the phenotype.
3. A capital letter (B) represents the gene as dominant.
4. A lower case letter (b) represents the gene as recessive.
5. Genes that are alike in an organism are called homozygous.
6. Genes that are different in an organism is called heterozygous.

**Circle the correct answer:**

7. Bb is (circle one) : homozygous or **heterozygous**?
8. BB is (circle one): **homozygous** or heterozygous?
9. bb is (circle one): **homozygous** or heterozygous?
10. B is (circle one): **dominant** or recessive?
11. b is (circle one): dominant or **recessive**?
12. Bb is the **genotype** or phenotype?
13. Black is the genotype or **phenotype**?
14. White is a genotype or **phenotype**?
15. BB is a **genotype** or a phenotype?
16. bb is a **genotype** or a phenotype?

**DIRECTIONS:** Work the following problems using the Punnett squares provided below and be sure to show ALL your work to include the genotype and phenotype results.

18. Cross a homozygous tall (A) plant homozygous short (a) plant.

Cross: AA X aa

Aa	Aa
Aa	Aa

Genotype %: 100%Aa  
Phenotype %: 100%Tall

19. Cross a heterozygous blue (B) plant with a homozygous red (b) plant.

Cross: Bb X bb

Bb	bb
Bb	bb

Genotype %: 50%Bb, bb  
Phenotype %: 50%Blue/red

20. Cross two heterozygous smooth (H) plants (h will be rough)

Cross: Hh X Hh

HH	Hh
Hh	hh

Genotype % \_\_\_\_\_  
Phenotype % \_\_\_\_\_

21. Cross a homozygous Blue plant with leaved a heterozygous Blue plant.

Cross: BB X Bb

BB	Bb
BB	Bb

Genotype % \_\_\_\_\_  
Phenotype % \_\_\_\_\_

22. Cross a heterozygous yellow (G) seeded plant with a green (g) seeded plant.

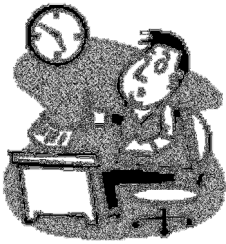
Cross: \_\_\_\_\_ X \_\_\_\_\_


Genotype % \_\_\_\_\_  
Phenotype % \_\_\_\_\_

23. Cross a homozygous smooth leaved plant (R) with a rough (r) leaved plant.

Cross: \_\_\_\_\_ X \_\_\_\_\_


Genotype % \_\_\_\_\_  
Phenotype % \_\_\_\_\_



# MORE PUNNETT PRACTICE !!!!!

Here are some more Punnett Squares for practice. Remember your definitions for the following problems:

- |         |  |  |                 |
|---------|--|--|-----------------|
| __ E __ | 1. Genes of an organism that are alike       |  | a. Dominant     |
| __ D __ | 2. Covers a weaker gene                      |  | b. Recessive    |
| __ F __ | 3. An organism that has different genes      |  | c. Genotype     |
| __ C __ | 4. The actual genetic make-up of an organism |  | d. Phenotype    |
| __ D __ | 5. The physical appearance of an organism    |  | e. Homozygous   |
| __ B __ | 6. A weaker gene that can be covered.        |  | f. Heterozygous |

**Punnett Practice:** Assign capital letter **G** to be the **DOMINANT** gene and lowercase **g** as the **recessive** gene for **every** punnett square.

**REMEMBER:** **GG OR gg** is Homozygous and **Gg** is Heterozygous. **G** is dominant and **g** is recessive.

**Green hair is DOMINANT over pink hair**

**G** will represent the dominant gene

**g** will represent the recessive gene

1. Homozygous Dominant X Homozygous Dominant: \_\_ GG \_\_ X \_\_ GG \_\_

GG	GG
GG	GG

Genotype %: \_\_ 100%GG \_\_

Phenotype %: \_\_ 100%Green \_\_

2. Homozygous Dominant X Homozygous Recessive: \_\_\_\_\_ X \_\_\_\_\_


Genotype %: \_\_\_\_\_

Phenotype %: \_\_\_\_\_

3. Heterozygous X Heterozygous: \_\_\_\_\_ X \_\_\_\_\_


Genotype %: \_\_\_\_\_

Phenotype %: \_\_\_\_\_

4. Heterozygous X Homozygous Recessive: \_\_\_\_\_ X \_\_\_\_\_


Genotype %: \_\_\_\_\_

Phenotype %: \_\_\_\_\_

5. Homozygous Recessive X Homozygous Recessive: \_\_\_\_\_ X \_\_\_\_\_


Genotype %: \_\_\_\_\_

Phenotype %: \_\_\_\_\_

Use the chart to identify the genotypes of the following traits and to solve the following problem:

Trait	Dominant gene	Recessive Gene
Body Shape	Squarepants (A)	Roundpants (a)
Body Color	Yellow (B)	Blue (b)
Eye Shape	Round (R)	Oval (r)
Nose Style	Long (L)	Stubby (l)

- Heterozygous round eyes, blue body Rrbb
- Hybrid (Heterozygous) eye shape, purebred (Homozygous) roundpants Rraa
- Purebred (Homozygous) roundpants, Hybrid (heterozygous) long nose aaLl

SpongeBob's Aunt Betty, who is a roundpants, has a cute, stubby nose. She has finally found the sponge of her dreams and is ready to settle down. Her new boyfriend, Tommy, always comments on how adorable her nose is (he says it reminds him of his mother's – awww isn't that sweet?) They wonder what the chances are that their children would have a stubby nose like Betty. Tommy is a purebred squarepants but is a hybrid for a long nose.

- What is the genotype of Aunt Betty and Tommy? aall x AALl  
 Aunt Betty = roundpants, stubby nose    Tommy = Purebred Squarepants, long nose

	<u>a</u>	<u>a</u>	<u>a</u>	<u>a</u>
<u>AL</u>	<u>AaLl</u>	<u>AaLl</u>	<u>AaLl</u>	<u>AaLl</u>
<u>Al</u>	<u>Aaall</u>	<u>Aaall</u>	<u>Aaall</u>	<u>Aaall</u>
<u>AL</u>	<u>AaLl</u>	<u>AaLl</u>	<u>AaLl</u>	<u>AaLl</u>
<u>Al</u>	<u>Aaall</u>	<u>Aaall</u>	<u>Aaall</u>	<u>Aaall</u>

Genotype ratio: 50% AaLl, 50% Aaall

Phenotype ratio: 50% Squarepants, Long nose  
50% Squarepants stubby nose

Using the dihybrid cross to the right, answer the following questions:

1. What is the cross for this dihybrid?

  AaBb   x   AaBb  

2. What are the chances of offspring being heterozygous for both traits?   4:16  

3. What are the chances of offspring being homozygous for long tails?   4:16  

4. What are the chances of the offspring being homozygous for being submissive and defeated?   4:16  

5. What are the chances of the offspring being without tails?   4:16  

6. What is the genotypic ratio of this dihybrid?  
  1AABB:2AABb:1AAbb:2AaBB:4AaBb:2Aabb:1aaBB:2aaBb:1aabb  

7. What is the phenotypic ratio of this dihybrid?

  8AaLl:3AaTl:3SLl:1STl  

**Dihybrid Cross**

Cross the Nittany Lion with a southern cougar



A for aggressive and victorious  
 a for submissive and defeated  
 B for long tailed  
 b for tailless



	AB	Ab	aB	ab
AB	 AABB	 AABb	 AaBB	 AaBb
Ab	 AABb	 AAbb	 AaBb	 Aabb
aB	 AaBB	 AaBb	 aaBB	 aaBb
ab	 AaBb	 Aabb	 aaBb	 aabb

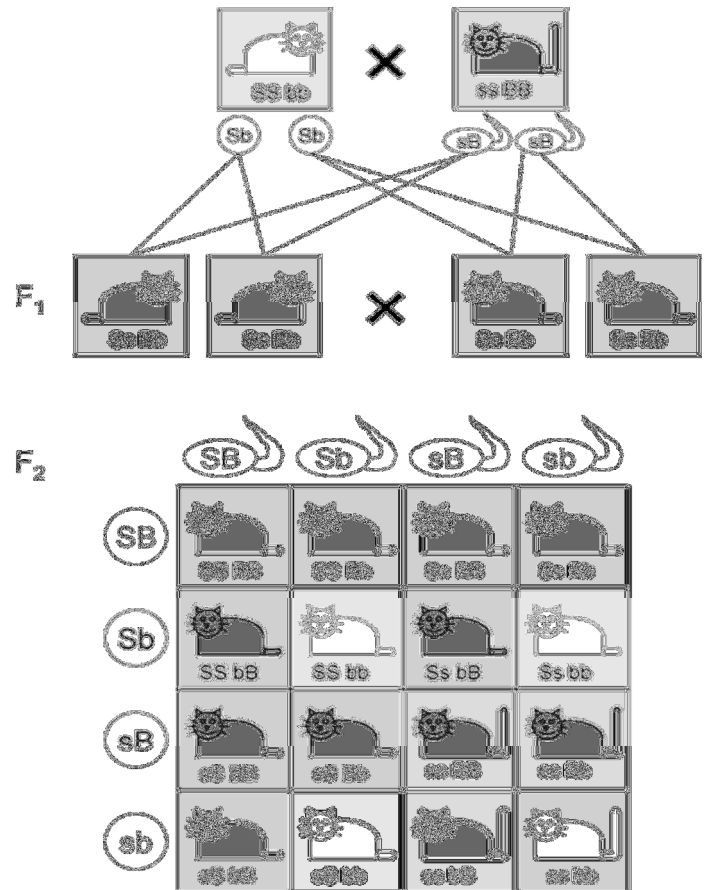
Using the diagram to the right, answer the following questions:

1. What **2 traits** do you think are being crossed?

  Fur color; Tail length  

2. What is the genotypic ratio illustrated in this dihybrid cross?

3. What is the phenotypic ratio illustrated in this dihybrid cross?





**PRACTICE WORKSHEET FOR OTHER PATTERNS OF INHERITANCE:**

**SEX-LINKED PUNNETT SQUARES:**

**CROSS:** A man with normal vision marries and has children with a woman who is a carrier of the colorblindness allele. What percentage of their offspring would be colorblind?

**CROSS:** \_\_\_\_\_ X \_\_\_\_\_


**Genotype %:** \_\_\_\_\_

**Phenotype %:** \_\_\_\_\_

**CROSS:** A normal blooded male marries and has children with a woman who is a carrier of the hemophilia allele. What percentage of their offspring will have hemophilia?

**CROSS:** \_\_\_\_\_ x \_\_\_\_\_


**Genotype %:** \_\_\_\_\_

**Phenotype %:** \_\_\_\_\_

**CROSS:** A colorblind male marries and has children with a woman who is a carrier of the colorblind allele. What percentage of their offspring will be carriers?

**CROSS:** \_\_\_\_\_ x \_\_\_\_\_


**Genotype %:** \_\_\_\_\_

**Phenotype %:** \_\_\_\_\_

### INCOMPLETE DOMINANCE PUNNETT SQUARES:

**CROSS:** In Andalusian fowls, Black individuals (B) and White individuals (W) are homozygous. Fill in the blanks below and do the punnett square. Be sure to show all of your work.

A homozygous black bird is crossed with a homozygous white bird. The offspring produced are bluish-gray.

**Genotypes:** Black bird = \_\_\_\_\_ White bird = \_\_\_\_\_ Offspring = \_\_\_\_\_

**CROSS:** What results if a black fowl is crossed with a bluish-gray fowl? Show all your work.

**Cross:** \_\_\_\_\_ x \_\_\_\_\_


**Genotype %:** \_\_\_\_\_

**Phenotype %:** \_\_\_\_\_

SpongeBob and his pal Patrick love to go jellyfishing at Jellyfish Field. The fields are home to a special type of green jellyfish known as Goobers and only really great fishermen are lucky enough to catch some on every trip. Many of the jellyfish are yellow (YY) or Blue (BB) but some end up green.

What would happen if SpongeBob and Patrick crossed two Goobers?

**Cross:** \_\_\_\_\_ x \_\_\_\_\_


What % offspring would be yellow? \_\_\_\_\_

What % offspring would be blue? \_\_\_\_\_

What % offspring would be Goobers? \_\_\_\_\_

### CO-DOMINANCE PUNNETT SQUARES:

Brad Pitt is homozygous Type B blood while Angelina Jolie is Type o blood. What are the possible genotype and phenotype % of their offspring?

**Cross:** \_\_\_\_\_ x \_\_\_\_\_


**Genotype %:** \_\_\_\_\_

**Phenotype %:** \_\_\_\_\_

## SELF QUIZ

- Which of the following accurately identifies all the possible combinations of genes in the offspring of two parents who are heterozygous for the gene with a dominant form (**R**) and a recessive form (**r**).
  - rr only
  - RR only
  - Rr and rr only
  - RR, Rr, and rr only**
- The process of DNA fingerprinting allows scientists to study organisms by doing which of the following?
  - Analyzing DNA left behind in the oily residue of fingerprints
  - Making images of sequences of DNA from individual organisms**
  - Breaking open an individual's cells to release the DNA fragments
  - Matching of base sequences in the DNA sample with that of finger cells
- Which statement best describes the significance of meiosis to sexual reproduction?
  - It produces haploid gametes, with half the number of chromosomes.**
  - It creates organisms with better adaptability to the environment.
  - It allows all types of cells to produce two sets of identical chromosomes.
  - It produces up to eight haploid cells, each with 46 chromosomes.
- If a corn plant has a genotype of **Ttyy**, what are the possible genetic combinations that could result in a single grain of pollen from this plant?
  - Ty, ty**
  - TY, ty
  - TY, Ty, ty
  - Ty, ty, tY, TY
- Which statement below best describes genetic modification?
  - It is a method of identifying proteins of particular DNA sequences.
  - It is the replacement of a set of chromosomes of an individual with another.
  - It is a technique used to compare DNA sequences of one individual to another.
  - It is the insertion of a gene from one organism into a host genome.**
- In fruit flies, the gene for eye color is located on the X chromosome, and the red eye allele (**R**) is dominant over the white eye allele (**r**). A female fly with genotype **XRXr** is mated with a male fly with genotype **XrY**. Which statement below best describes the expected outcome of this cross?
  - XrY = 0%
  - XRY = 25%**
  - XrXr = 50%
  - XRXR = 100%

7. In certain rose plants, white roses (**W**) and red roses (**R**) are incompletely dominant to one another. When a red rose is crossed with a white rose, a pink rose(**RW**) will result. What is the probability of producing more pink roses from two pink parents?
- A. 0%
  - B. 25%
  - C. 50%
  - D. 100%

8. The gene for tallness (**T**) in a pea plant is dominant over the gene for shortness (**t**). The Punnett square below shows the cross between **two** tall pea plants (**Tt**). What is the phenotypic ratio of the offspring produced as a result of the cross?

	T	t
T	TT	Tt
t	Tt	tt

- A. 1:2:1
  - B. 9:3:3:1
  - C. 3:1
  - D. 2:1
9. Nondisjunction is an error that occurs during meiosis when a gamete does not receive a copy of one chromosome. Which technique can be used to reveal this abnormality?
- A. DNA fingerprinting
  - B. Gel electrophoresis
  - C. Karyotyping
  - D. Genetic modification
10. During meiosis, genetic recombination results because –
- A. chromosomes assort independently, and crossing-over occurs
  - B. genes from different species can freely mix together
  - C. gene mutations occur more frequently than at other times
  - D. cells divide only once, resulting in genetically identical cells
11. What is the probability that a yellow (**Y**) and wrinkled pea (**r**) will appear from a cross of **Yyrr x YyRr**?
- A. 3/8
  - B. 1/2
  - C. 3/4
  - D. 7/8