

## Fun with Punnetts (Dihybrid / Complete)

Inheritance (Unit 4) - Biology

Name: \_\_\_\_\_

Block: \_\_\_\_\_ Date: \_\_\_\_\_

First, you need to know the basic terms.

Term	Definition/Description
Cross	When two organisms sexually reproduce and make offspring.
Monohybrid cross	A cross that focuses on only <b>one</b> trait, such as eye color <b>or</b> fur color. (Mono- means one.) The Punnett square for a monohybrid cross has 4 boxes.
Dihybrid cross	A cross that focuses on <b>two</b> traits, such as eye color <b>and</b> fur color. (Di- means two.) The Punnett square for a dihybrid cross has 16 boxes.
Allele	One of two genes inherited for a trait. You got one allele for your eye color from your dad and one allele for eye color from your mom.
Genotype	The two alleles someone has for a specific trait. A dog's genotype for eye color could be BB (brown), Bb (brown), or bb (blue). A dog's genotype for fur color could be GG (golden), Gg (golden), or gg (tan). <b>A dihybrid genotype has 4 alleles because it involves two traits.</b> Examples: BBGg (brown-eyed with golden fur) or bbgg (blue-eyed with tan fur)
Phenotype	The <b>physical</b> expression of your genotype. For example, BB and Bb might give you brown eyes, while bb gives you blue eyes.
Dominant	When an allele is completely dominant, it 'masks' or 'hides' the other allele. Dominant alleles are written with a capital letter. So if someone has the genotype Bb, they have the dominant phenotype (brown eyes).
Recessive	The allele that gets masked or hidden by the dominant allele. Recessive alleles are written with a lowercase letter. To have the recessive trait, you must have two recessive alleles (zero dominant alleles). So if someone has the genotype bb, they have the recessive phenotype (blue eyes).
Homozygous dominant	The genotype with two dominant alleles (BB). This person has the dominant phenotype (brown eyes).
Homozygous recessive	The genotype with two recessive alleles (bb). This person has the recessive phenotype (blue eyes).
Heterozygous	The genotype with one dominant allele and one recessive allele (Bb). This person <b>carries</b> a recessive allele but <b>has</b> the dominant phenotype (brown eyes) because the dominant one wins.

Let's practice the terms.

- An example of a dihybrid cross. (If you're doing the online version, type A or B here: \_\_\_\_\_)
  - Breeding a cat that has long legs with a cat that has short legs
  - Breeding a cat that has long legs and a short tail with a cat that has short legs and a short tail
- A dihybrid genotype for a plant with a thick stem (thick=T) and green leaves (green=G)  
(If you're doing the online version, type A, B, C, or D here: \_\_\_\_\_)
  - TG
  - Tg
  - TTGg
  - ttGG
- A dihybrid genotype for a flower with wide petals (wide=W) and purple color (red=R).  
(If you're doing the online version, type A, B, C, or D here: \_\_\_\_\_)
  - WM
  - Wm
  - WWMm
  - Wwmm

Now let's see what happens when we do a dihybrid cross with two monsters.

**Trait #1:** T = has a tail ... t = doesn't have a tail

4. Which trait is dominant? having a tail    not having a tail (Circle one or type it here: \_\_\_\_\_)

**Trait #2:** E = big ears ... e = small ears

5. What phenotype does a heterozygous monster have? big ears    small ears (Circle one or type it here: \_\_\_\_\_)

**Mom Monster doesn't have a tail, and she's heterozygous for big ears.**

6. What's her genotype? \_\_\_\_\_ (Remember it needs four alleles – two for each gene!)

To figure out what the offspring of Mom Monster and Dad Monster might look like, we need to make a dihybrid Punnett Square. This is what a blank dihybrid Punnett square looks like:


For a monohybrid Punnett square, we'd write one allele above each column and one allele to the left of each row. But the point of a dihybrid Punnett square is to figure out which **two** traits the offspring are likely to have. That means **we need to write two alleles above each column and two alleles to the left of each row** – that's one for each trait. Each pair of alleles represents one possibility of what could be in that parent's gametes (because gametes have a random **half** of the parent's genetic information).

So to figure out what goes along the top and down the side of a dihybrid Punnett square, we first need to figure out all the possible allele combinations for each parent. To do that quickly, we use a cheat called FOIL.

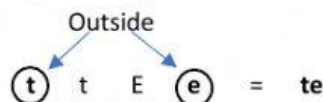
Here's how it works...

**Mom Monster's genotype is ttEe.**

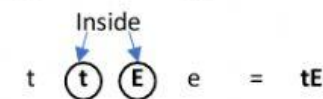
- First – Take the **first** allele from each pair:



- Outside – Take the two alleles on the **outside** of the genotype:



- Inside – Take the two alleles on the **inside** of the genotype:



- Last – Take the **last** allele from each pair:



Now we know the four possible allele combinations for Mom Monster's genotype, and we can write them along the top of the dihybrid Punnett Square. (Completed for you on the next page)

	tE	te	tE	te
—				
—				
—				
—				

**Your turn! Dad Monster is heterozygous for Trait #1, and he has small ears.**

- What's his genotype? \_\_\_\_\_ (Remember it needs four alleles – two for each gene!)
- Use FOIL to find the four possible combinations of alleles in his gametes, and write them along the left side of the Punnett Square above.
  - First: \_\_\_\_
  - Outside: \_\_\_\_
  - Inside: \_\_\_\_
  - Last: \_\_\_\_
- Complete the Punnett square. **Important:** Keep the alleles for each trait together, and put dominant alleles first. (See the example below.)
- What is the likelihood that their children will have a tail **and** big ears? \_\_\_\_ / 16

**Example of a completed dihybrid Punnett Square**

- Notice that the alleles for each trait are kept together. Example: TtBb instead of TBtb
  - And also that the capital letters always go first for each trait. Example: TtBb instead of tTbB
- Both of these tips will make the results easier to read and count!

Cross: TtBb x TtBb

	TB	Tb	tB	tb
TB	TTBB	TTBb	TtBB	TtBb
Tb	TTBb	TTbb	TtBb	Ttbb
tB	TtBB	TtBb	ttBB	ttBb
tb	TtBb	Ttbb	ttBb	ttbb

**Let's try with a new monster couple!**

11. A Mom Monster is homozygous dominant for both traits. What is her genotype? \_\_\_\_\_
12. What would be the results of a FOIL of her genotype?   \_\_   \_\_   \_\_   \_\_
  
13. A Dad Monster is heterozygous for both traits. What is his genotype? \_\_\_\_\_
14. What would be the results of a FOIL of his genotype?   \_\_   \_\_   \_\_   \_\_
  
15. Complete the Punnett Square below.
16. What is the likelihood that their children will have both dominant traits? \_\_\_\_ / 16
17. What is the likelihood that their children will have the Dad Monster's genotype? \_\_\_\_ / 16


**What questions do you have? Ask your teacher!!**