Name: _____ Period: _____

Introduction to Punnett Squares

We can predict the probability that a combination of genes will happen in certain offspring of a specific cross of two individuals by using a diagram called a Punnett square. There are specific steps to follow to create an appropriate Punnett square. We'll work through an example together, but first, there is some vocabulary that you must know.

homozygous – ("same" "joined") organisms that have 2 identical alleles for a particular trait
- homozygous dominant – two dominant alleles (TT)
- homozygous recessive – two recessive alleles (tt)

heterozygous – ("other" "joined") organisms that have 2 different alleles for a particular trait (Tt), another word that means the same thing as heterozygous is _____.

phenotype – describes the **ph**ysical characteristics (tall, yellow, short, freckled, etc. – what does the organism **look like?**)

genotype – describes the **gen**etic makeup (TT, rr, Nn, etc. – what **alleles** does the organism have?)

Sample Problem: In pea plants, red flowers are dominant over white flowers. A heterozygous red flowering plant is allowed to self-pollinate. What are the genotype and phenotype probabilities for the offspring of this plant?

Step 1: Identify the important information in the prompt.
Underline the information that tells you which are the dominant and recessive traits/alleles. Put a box around the text that describes the parent(s).

Step 2: Choose a letter to represent the alleles in the cross.
It is not really that important which letter you select, but it makes sense to choose one that has something to do with the problem. Look at the text you underlined and pick letters to represent the dominant and recessive alleles.

For this problem, let's use ____ for the dominant red allele and ____ for the recessive white allele.

Step 3: Write out the "cross" using an X and the genotypes of the parents.
Look at the text that you boxed to find the parents. Although there is only one parent involved in this cross, you must still write it as a cross in which you account for a female parent and a male parent, because the parent has both male and female parts. This cross will be written as:

_____ X _____

This equation would be read as "a heterozygous red plant crossed with a heterozygous red plant".

Step 4: **Determine the possible gametes that the parents can produce.**
Remember that alleles are segregated during the formation of gametes.

Step 5: **Enter the possible gametes for one parent down the side of the Punnett square, and the gametes for the other parent across the top of the Punnett square.**
At this step, your entire diagram should look like this.

Key: _____ = red _____ = white _____ X _____

Step 6: **Complete the Punnett square by writing the alleles from the gametes in the appropriate boxes.**
This step represents the process of fertilization. The allele from the gamete above the box and the allele from the gamete to the side of the box are combined inside each of the four boxes. If there is a combination of a capital letter with a lowercase letter, write the capital letter first. The letters inside the box represent the probable genotypes of the offspring resulting from the cross.

Key: _____ = red _____ = white _____ X _____

Genotype Probability

homozygous dominant = _____

homozygous recessive = _____

heterozygous = _____

Phenotype Probability

red flowers = _____

white flowers = _____

Now try creating a Punnett square to solve different problems, using the previous steps.

Problem 1: For tigers, albinism (lack of pigmentation) is a recessive trait. A homozygous dominant tiger is crossed with a tiger that is a carrier of albinism (heterozygous). What are the probable genotype and phenotype of the offspring of these tigers?

Key: _____ = not albino _____ = albino **_____ X _____**

Genotype

homozygous dominant = _____

homozygous recessive = _____

heterozygous = _____

Phenotype

not albino = _____

albino = _____

Problem 2: A butterfly breeder has two butterflies that are heterozygous for the color trait. For this species of butterfly, green is the dominant color, and yellow is the recessive color.

What is the phenotype of her heterozygous butterflies? _____

What are the probable genotype and phenotype of the offspring of these butterflies?

Key: _____ = green _____ = yellow **_____ X _____**

Genotype

homozygous dominant = _____

homozygous recessive = _____

heterozygous = _____

Phenotype

green = _____

yellow = _____

Each time these two heterozygous butterflies breed, what is the likelihood that the offspring will be yellow?

Is this the exact proportion of offspring that will be yellow (will exactly 25% be yellow)? How can the breeder obtain actual offspring ratios that are as close to the expected ratios as possible?

If the butterfly breeder is trying to get yellow butterflies, what should she do?

Problem 3: This time you will cross two pea plants that are homozygous recessive for seed shape. Round seeds are the dominant trait, and wrinkled seeds are the recessive trait. What are the probable genotype and phenotype of the offspring of these pea plants?

Key: _____ = round _____ = wrinkled **_____ X _____**

Genotype

homozygous dominant = _____

homozygous recessive = _____

heterozygous = _____

Phenotype

round seed = _____

wrinkled seed = _____

Problem 4: In pea plants, shortness is a recessive trait while tallness is dominant. If one pea plant is short and the other plant is a hybrid, what are the probable genotype and phenotype of the offspring?

Key: _____ = tall _____ = short **_____ X _____**

Genotype

homozygous dominant = _____

homozygous recessive = _____

heterozygous = _____

Phenotype

tall = _____

short = _____

Problem 5: Blue eyes are a recessive trait. If a parent with blue eyes and a heterozygous, brown-eyed parent have a child, what are the chances the child will have blue eyes?

Key: _____ = brown eyes _____ = blue eyes **_____ X _____**
