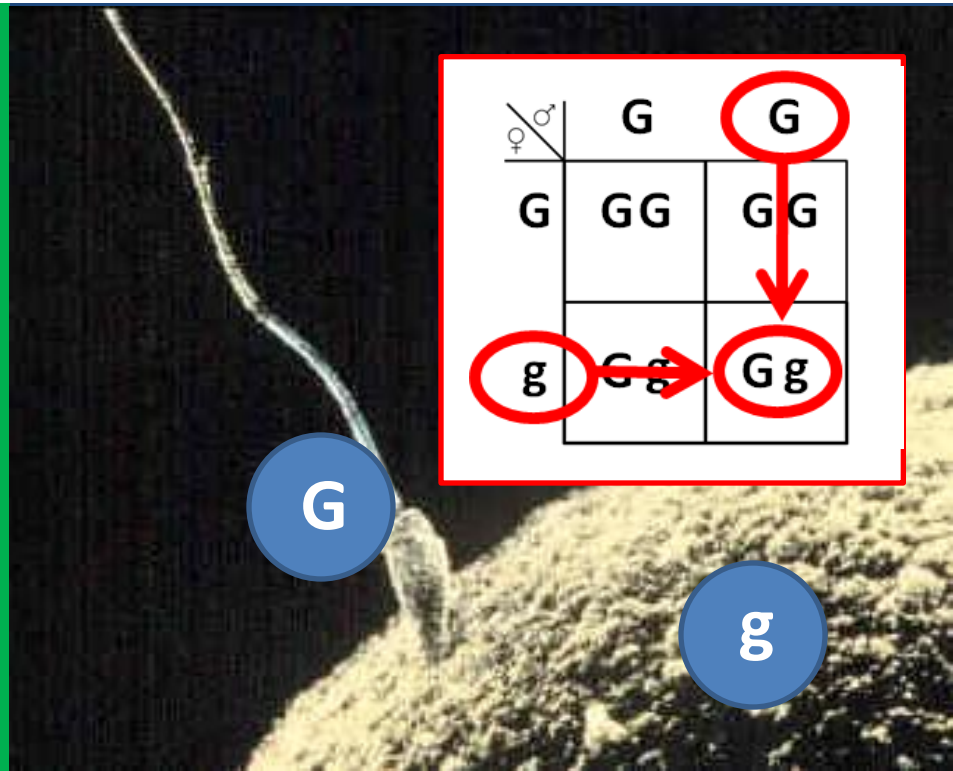
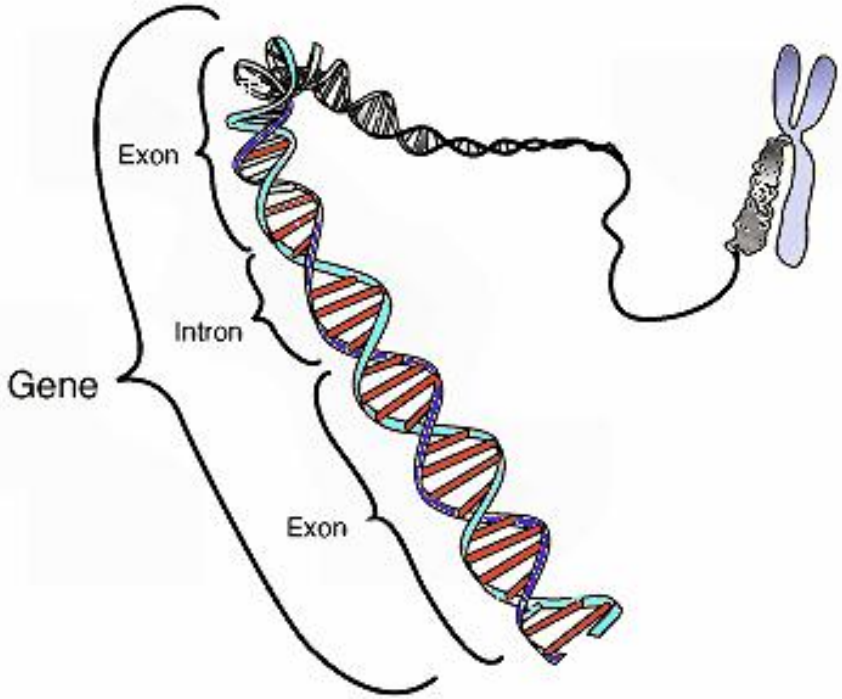
		pollen ♂ B	pollen ♂ b
pistil ♀	B	BB	Bb
pistil ♀	b	Bb	bb

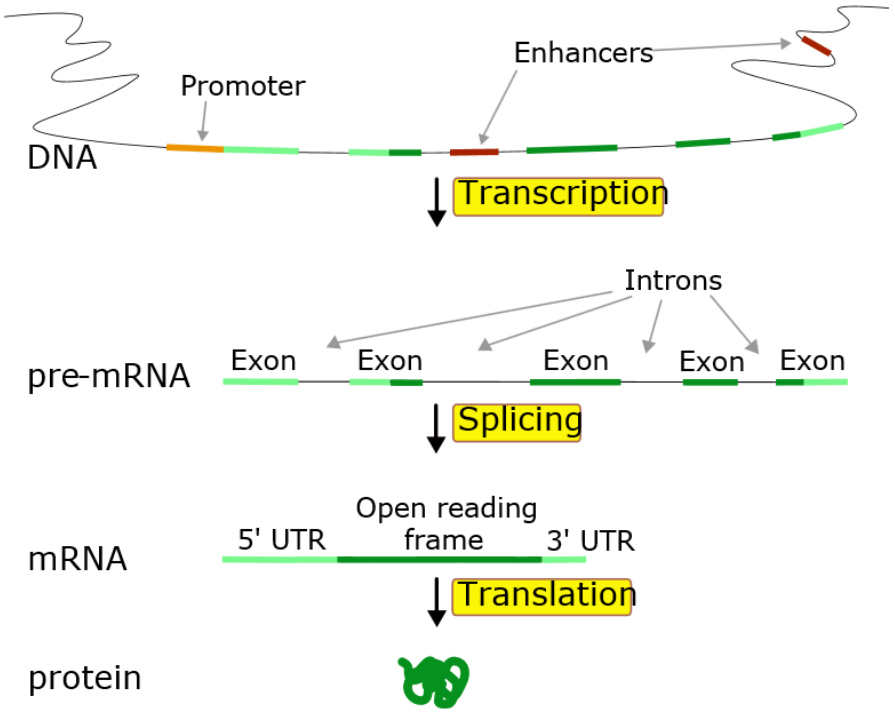
Image by Madeleine Price Ball

Punnett Squares

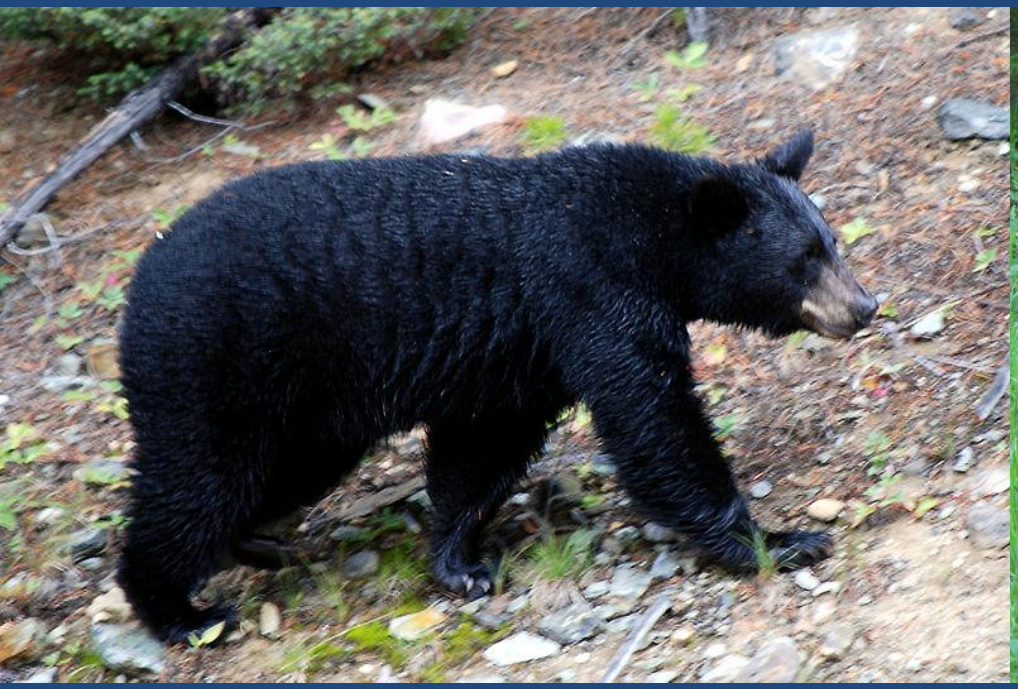


The ***sequence of nitrogen bases*** in DNA provides the instructions for making proteins. This is known as the *genetic code*, and each section of DNA that is used to make a protein is called a **gene**.





Every bear has a hair color gene, but they do not all have the same version of the gene. The *different versions of a gene* are called **alleles**. Some bears have the *allele* for **black fur** and some bears have the *allele* for **brown fur**.



Each *diploid* organism has 2 copies of every gene. The alleles on each chromosome interact with one another in a way that determines how the genes will be ***expressed***.

	Subject A	Subject B	Subject C
Genotype for Fur Color	GG	Gg	gg
Phenotype for Fur Color	Gray Fur	Gray Fur	White Fur

Dominant alleles are always expressed.

They are represented by a *capital letter*.

	Subject A	Subject B	Subject C
Genotype for Fur Color	GG	Gg	gg
Phenotype for Fur Color	Gray Fur	Gray Fur	White Fur

Recessive alleles are only expressed if both alleles are the recessive version.

They are represented by a *lowercase letter*.

Homozygous vs. Heterozygous

Use your vocabulary reference sheet to define the following prefixes and suffixes.

Homo- *Hetero-* *-zygous*

Homo- means same

Hetero- means different

-Zygous means joined together

Homozygous means the *same alleles* have joined together

Heterozygous means *different alleles* have joined together

Homozygous vs. Heterozygous

Organisms that are *homozygous* will either be homozygous dominant or homozygous recessive. It is important that you identify which types of alleles are alike in the organism.

Homozygous dominant = GG, BB, WW, YY, etc.

Homozygous recessive = gg, bb, ww, yy, etc.

Heterozygous organisms always contain different alleles: 1 dominant and 1 recessive.

Heterozygous = Gg, Bb, Ww, Yy, etc.

The *combination of alleles* is known as the organism's genotype.

Gg

	Subject A	Subject B	Subject C
Genotype for Fur Color	GG	Gg	gg
Phenotype for Fur Color	Gray Fur	Gray Fur	White Fur

The *physical appearance* caused by the expression of the alleles is the phenotype.

Punnett Squares

We can predict the possible *genotypes* and *phenotypes* of the offspring that a set of parents might create. We do this using a tool called a Punnett square.

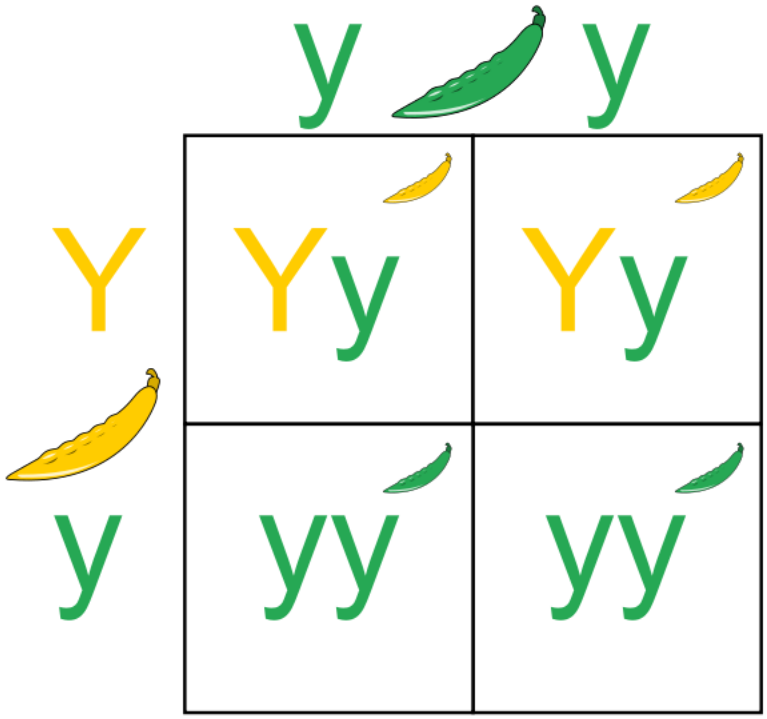


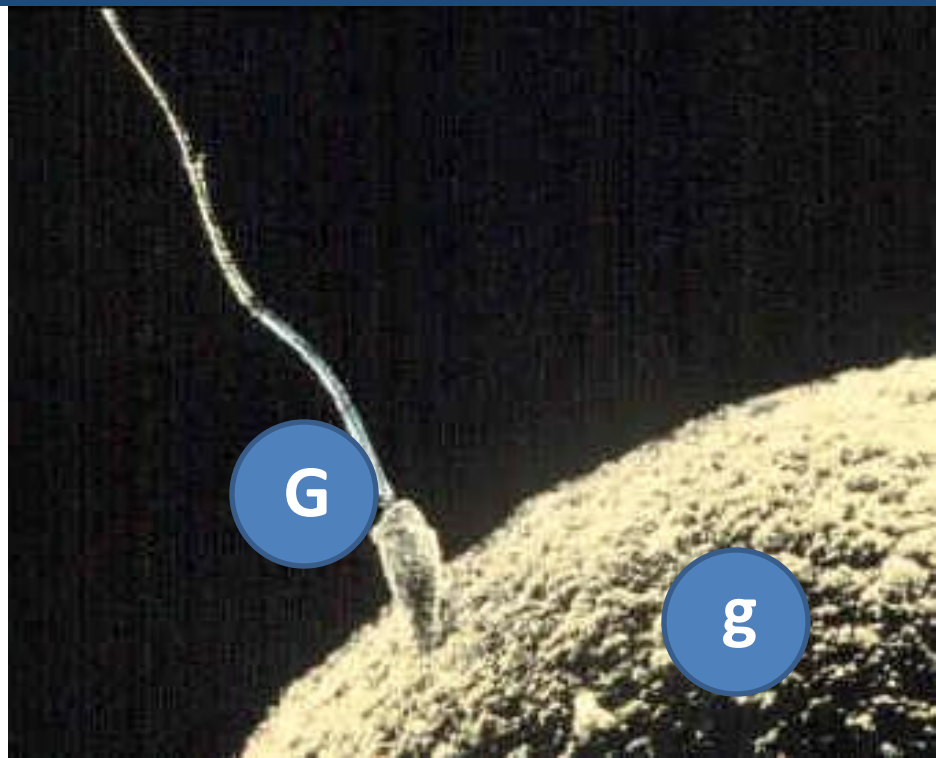
Image by Pbroks13

Punnett Squares

Each box represents a possible *combination of alleles* that would occur when gamete cells fuse together during sexual reproduction.

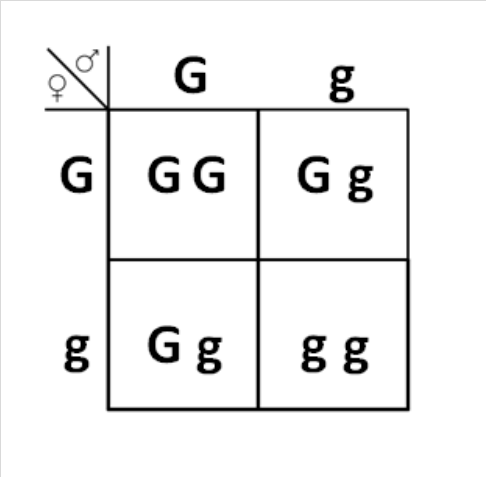
♀ \ ♂	G	G
G	GG	G G
g	G g	G g

GG (male) × Gg (female)



Punnett Squares

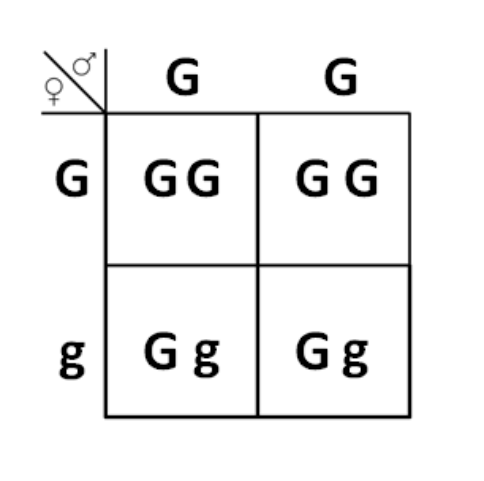
There are 3 main ways we will report the results of a Punnett square



♀ \ ♂	G	g
G	G G	G g
g	G g	g g

Percentages

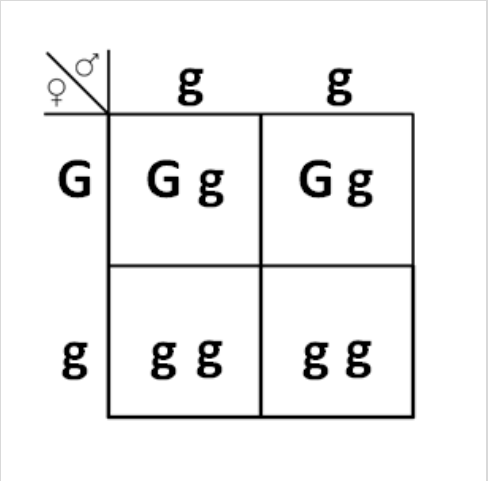
75% of the offspring will have gray fur.



♀ \ ♂	G	G
G	G G	G G
g	G g	G g

Fractions

½ of the offspring will have heterozygous genotypes.

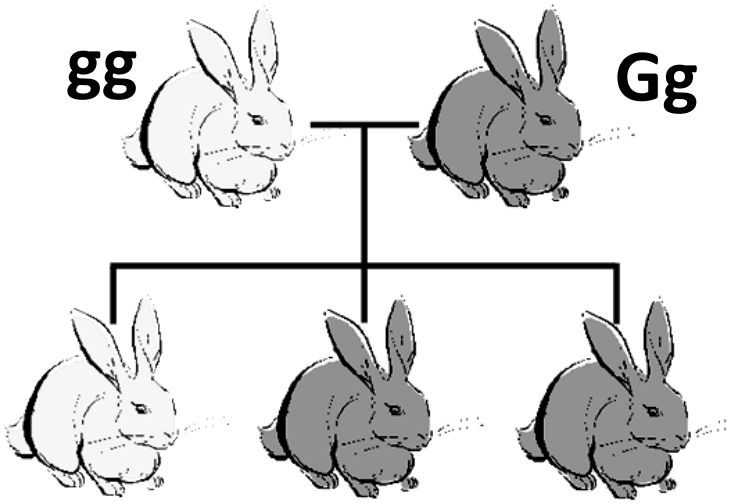


♀ \ ♂	g	g
G	G g	G g
g	g g	g g

Ratios

The ratio of offspring with gray fur to white fur is

1 : 1



♀ \ ♂	g	g
G	G g	G g
g	g g	g g

The ratio of offspring with gray fur to white fur is

1 : 1

It is important to understand that these are *predictions* and NO guarantees. In order to really see these numbers work out you often need to see LOTS of offspring.