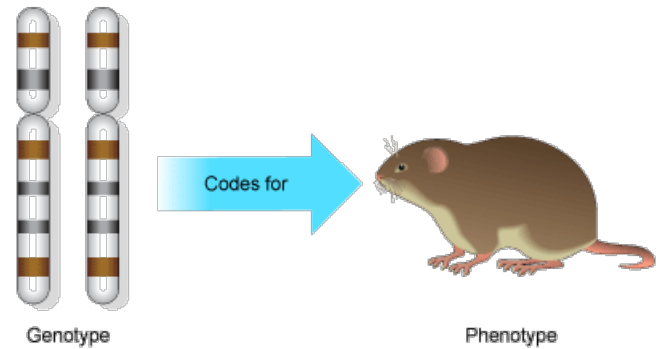




Phenotype and Genotype

The combination of alleles for each trait is called the **genotype**; this can be any combination of two of the available alleles.



The **phenotype** is the physical trait that is expressed because of the alleles. The genotype determines the phenotype (the physical appearance) of the organism.

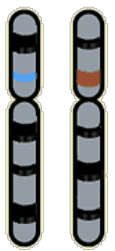


Dominant and recessive alleles

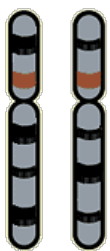
Alleles that are present in the pair are expressed. **Dominant** alleles (B) if present will be expressed over **recessive** alleles (b).

Only if there are no dominant alleles present in the pair will the recessive allele be expressed. Expressed means the protein is produced which determines the characteristic.

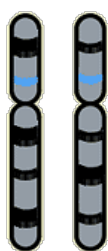
 = allele for blue eyes (recessive)
 = allele for brown eyes (dominant)



Individual A:
heterozygous



Individual B:
homozygous






Individual C:
homozygous
recessive

When there are two of the same alleles, this is called **homozygous** and the cell could randomly use either allele. When there are two different alleles this is called **heterozygous** and the cell always uses the dominant allele. **Pure Breeding** is another term for homozygous.

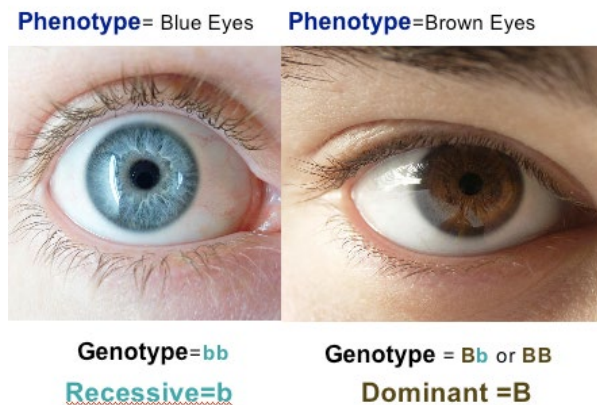
Recessive alleles need 2 copies present to be expressed in the phenotype. Dominant allele needs only 1 copy present to be expressed and is always expressed when present

Many letters can be used to represent dominant or recessive, such as Bb, Ee, Ff as long as the upper- and lower-case letters look different. **The genotype determines the phenotype.**

Genotype	Phenotype
EE Homozygous dominant	Detached Earlobes 
Ee Heterozygous	Detached Earlobes 
ee Homozygous recessive	Attached Earlobes 

Phenotype, genotype and dominance

When the **phenotype** is recessive then the **genotype** can only be homozygous recessive. If the phenotype is dominant then the genotype can either be heterozygous or homozygous dominant, as long as one dominant allele is present in the genotype.



Lop eared rabbits – an example

Rabbit ears normally point straight up. Some rabbits have an allele for lop ears that cause the ears fold down. The allele that produces lop ears is recessive and was created by a **mutation**. We can use the symbol R to show the dominant allele and r to show the recessive allele.

The genotype of the two rabbits if both are **pure breeding** are:

Lop eared rabbit genotype rr

Normal eared rabbit genotype RR



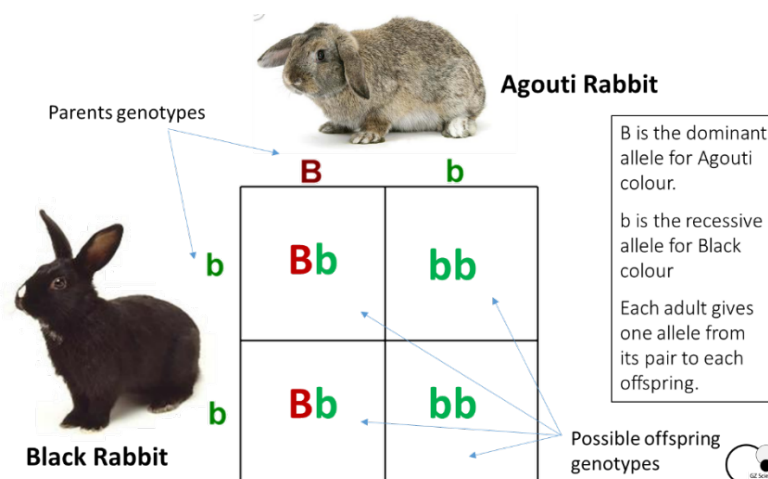
lop eared rabbit



straight eared rabbit

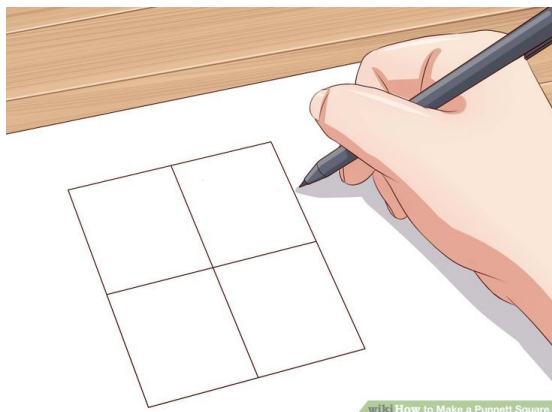
Punnett squares

We use Punnett squares to predict the frequency of the genotypes of any offspring created when two organisms are mated, and therefore phenotypes.



Using a Punnett Square to predict offspring

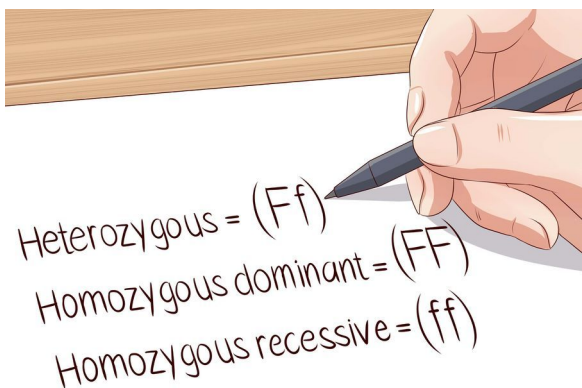
1. Draw a grid with 4 squares. Each square will represent 1 out of 4 offspring or 25% of offspring out of 100%



2. Write down the possible 2 phenotypes (physical traits) and label them with a capital letter for the dominant trait and lower case letter for the recessive trait.



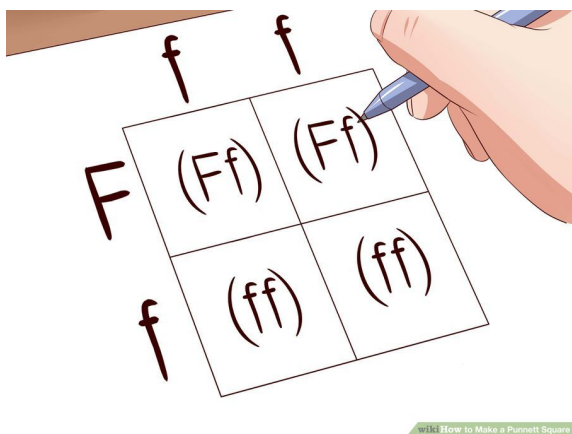
3. Write down all 3 possible genotypes and their letter combinations.



4. Select the correct genotypes for each parent (they may be the same or different) and write them with one parent on the top and one parent to the left side.

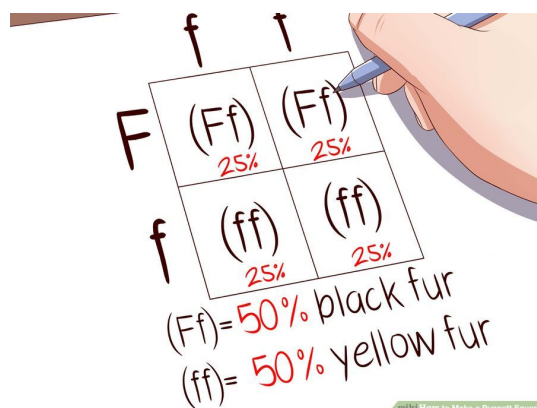


5. Write each letter in the square below for one parent and squares to the right for the other parent. Each offspring will have a genotype of 2 letters.



6. Calculate the genotype ratio – the total percentage each genotype occurs (in this order FF: Ff : ff) or total out of 4 squares.

Then calculate phenotype ratio – FF and Ff count as dominant and only ff counts as recessive (in this order dominant : recessive) can be % or out of 4



The Punnett square is used to predict the **probability** of what the offspring's phenotype and genotype will be, which may or may not match up to the actual results due to the random nature of each fertilisation.

The phenotype and genotype ratios are only **predictions**. Each time a new offspring is created through fertilisation it is a new event and the same probabilities apply regardless of the phenotype or genotype of previous offspring.

Calculating Phenotype and genotype ratios example

	R	r
R	RR	Rr
r	Rr	rr

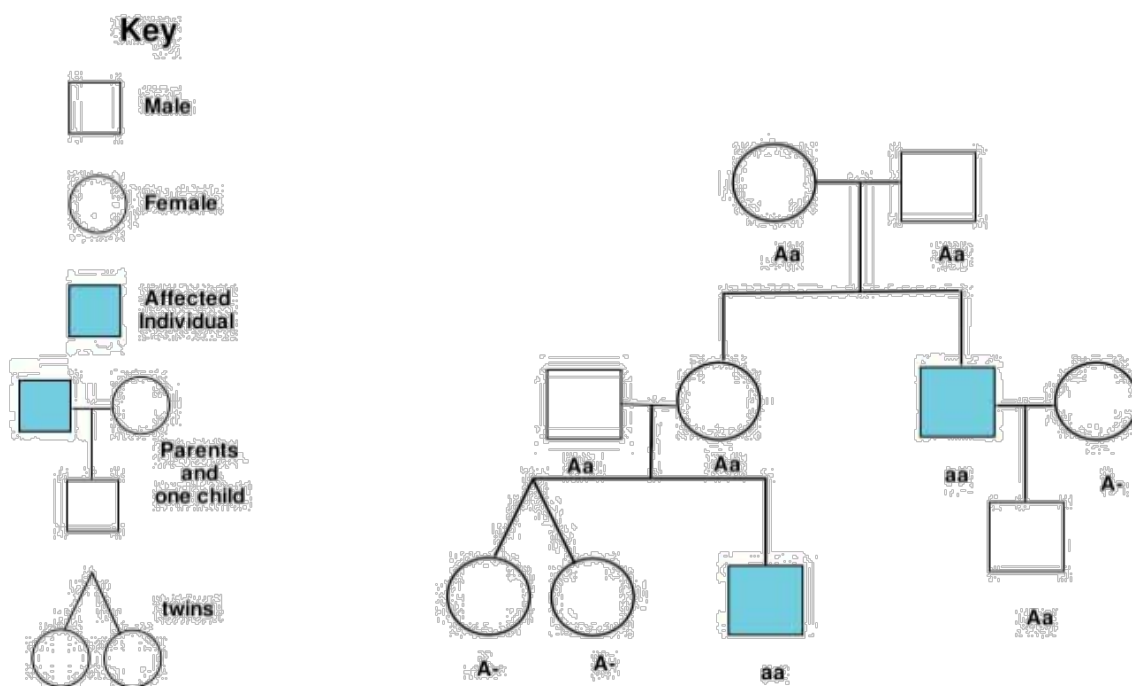


Genotype Ratios		
RR	Rr	rr
1	2	1
Phenotype Ratios		
Straight Ears		Lop ears
3		1

We can use the example of our straight eared and lop-eared rabbit again when they breed, and all their offspring will have the genotype of Rr and phenotype of straight ears. If we cross two of their offspring (Rr) the genotype and phenotype ratios of **their offspring** (second generation) can be set out as beside

Pedigree charts

A pedigree chart is a diagram that shows **inheritance** patterns of a certain allele. A **square represents a male** and a **circle represents a female**. If a person's symbol is shaded in, this means that they have the phenotype. If it is half-shaded, then they are heterozygous but do not have the phenotype. If they are not shaded at all, they do not have the allele. Pedigree charts are good for showing the patterns of a recessive or dominant gene.





1a. The Pea flower colour is determined by a pair of alleles. Label the pairs of alleles as either homozygous recessive, homozygous dominant or heterozygous



AA

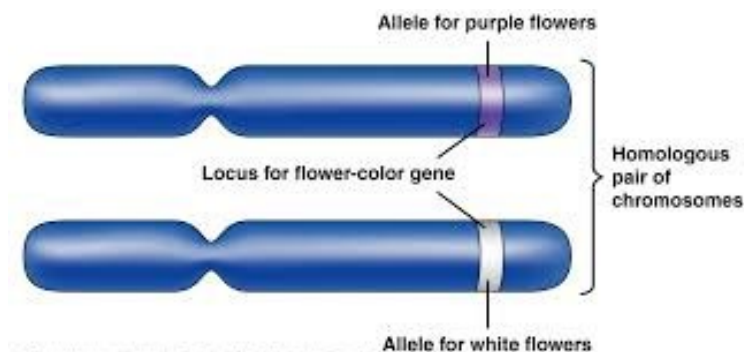
Aa

aa

The flower colours are either dark/purple or white.

1b. which colour is dominant?

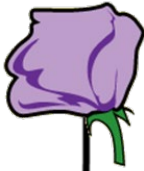

2a. Below is a pair of chromosomes from the same pea plant. The diagram shows the location of the alleles for flower colour.



2b. What is the **term** we give the white allele and what **symbol** would we give it?

2c. Based on the alleles above what **colour** would we expect the pea plant flowers to be?

3a. Two flowers are crossed. Use the Punnett square to show the possible offspring

	A  a	
A  a		

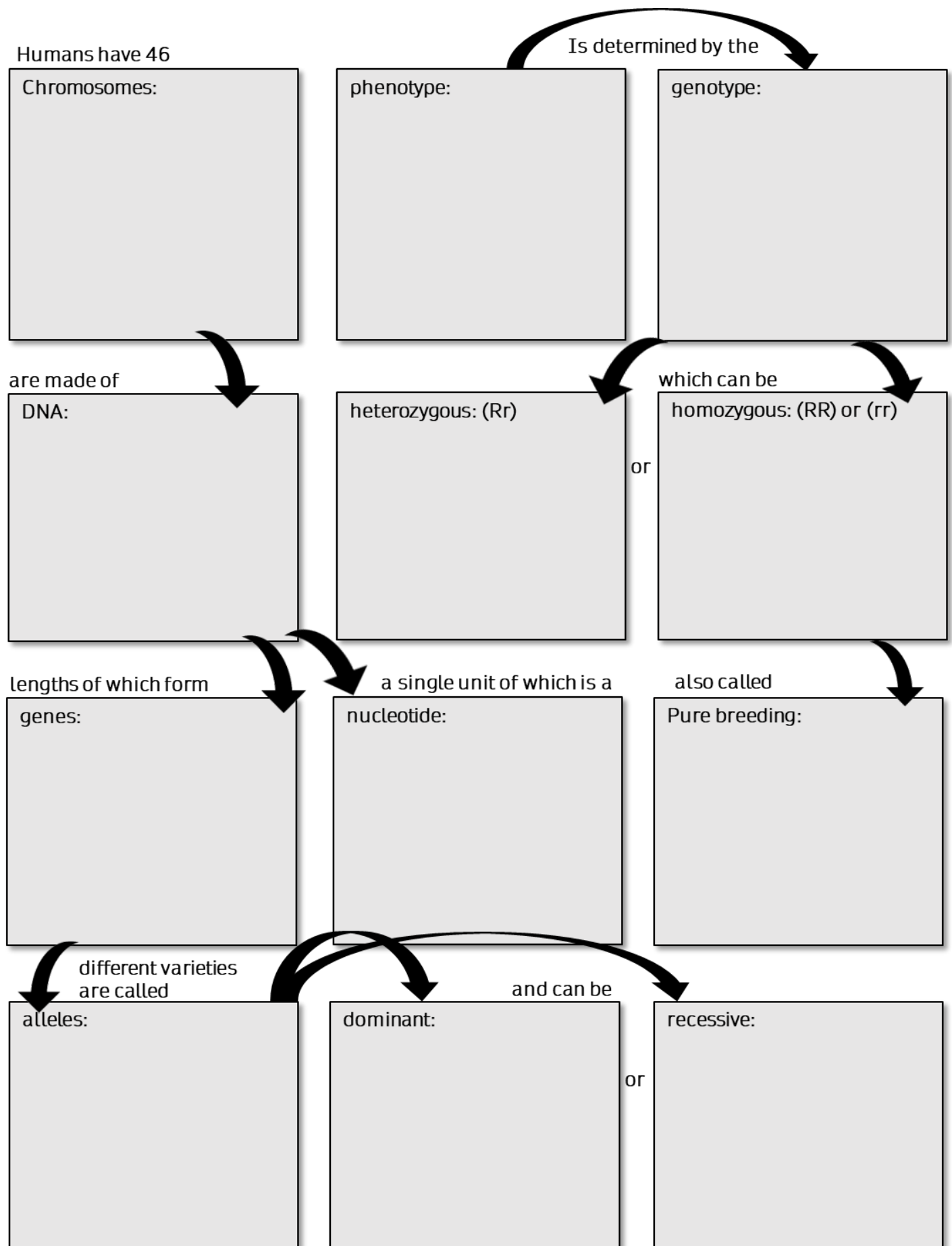
3b. How many of the offspring (of the 4) are AA?

3c. How many of the offspring are heterozygous?

3d. How many of the offspring will be dark/purple?

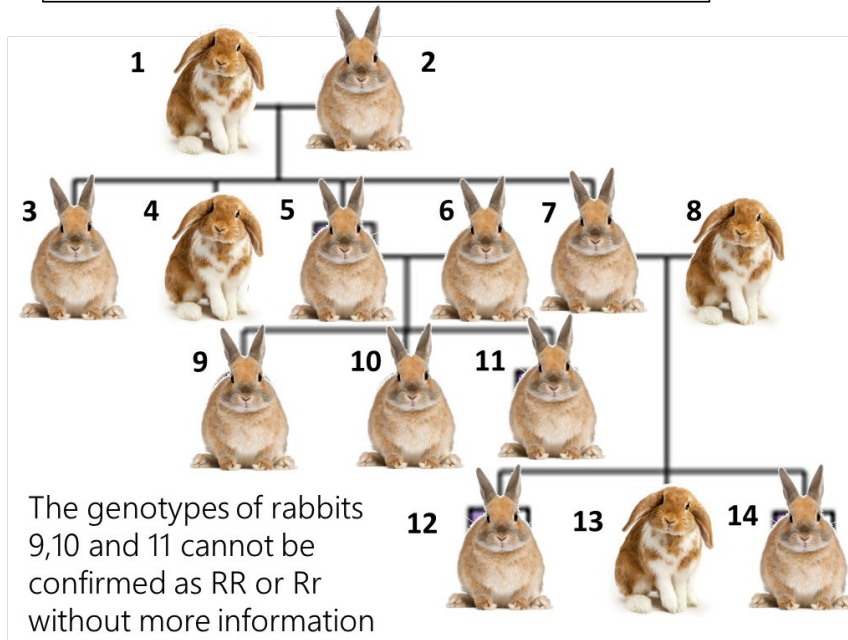
3e. What is the genotype ratio (AA:Aa:aa)?

4. Fill in the genetics terms with either definitions or diagrams



EXTENSION

5. Use the pedigree chart below to answer the following questions. Remember that BOTH parents must give one allele each to their offspring.



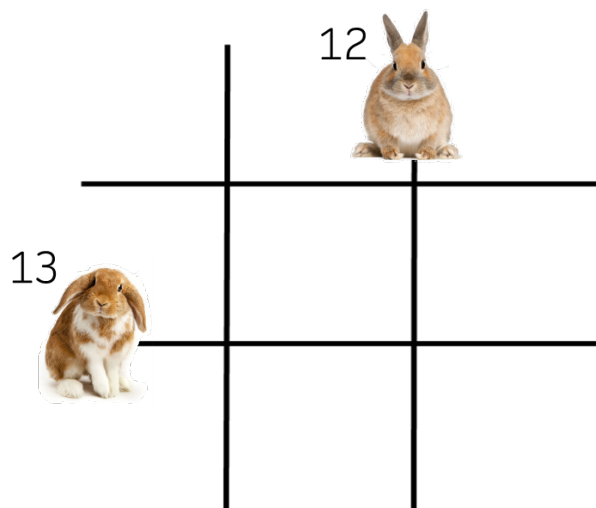
5a. List the rabbits that have the genotype rr

5b. What genotype is rabbit 3?

5c. what phenotype is rabbit 14?

5d. What genotype is rabbit 2, and what evidence do you have to make this claim?

6. Complete the Punnet Square and calculate the phenotype and genotype ratios



Genotype Ratios		
RR	Rr	rr
<input type="text"/>	<input type="text"/>	<input type="text"/>
Phenotype Ratios		
Straight Ears	Lop ears	
<input type="text"/>	<input type="text"/>	