Punnett Square Practice #1

Remind yourself of the following definitions:

Allele: a distinct version of a gene

Dominant: form of a trait (allele) that will be expressed if present

Recessive: form of a trait (allele) that is only expressed if inherited from both parents

Segregation of Alleles: offspring receive 2 alleles for each gene, one from each parent

True Breeding: parents both have homozygous genotypes

Genotype: genetic makeup of a trait

Phenotype: physical appearance of a trait

Homozygous: pair of alleles identical for a certain trait

Heterozygous: pair of alleles are different for a certain trait

Use the following list of pea plant traits to complete the table and answer the questions

Assume that all parents are homozygous

Traits of Pea Plants		
Trait	**Dominant**	**Recessive**
Seed Shape	Round (R)	Wrinkled (r)
Seed Color	Yellow (Y)	Green (y)
Flower Color	Purple (W)	White (w)
Pod Shape	Inflated (I)	Constricted (i)
Plant Height	Tall (T)	Short (t)

Parent Plants	Offspring Generation 1	
	Genotype	**Phenotype**
Round x Wrinkled RR x rr	Rr	round
Yellow x green YY x yy	Yy	yellow
Purple x white WW x ww	Ww	purple
Tall x short TT x tt	Tt	tall
Inflated x constricted II x ii	Ii	inflated

Use punnett squares to predict the results of the following crosses in garden peas. Indicate the expected ratios for the genotypes and phenotypes of the offspring.

A. Tall homozygous plants are **cross-pollinated** with short pea plants:

genotype options: TT, tt, Tt

phenotype options: tall, short

	T	T
t	Tt	Tt
t	Tt	Tt

Genotype ratios: 4:0:0 Phenotype ratios: 4:0

B. The offspring from Cross A are allowed to self pollinate and reproduce asexually

1 (TT) : 2 (Tt) : 1 (tt)

3 (tall) : 1 (short)

	T	t
T	TT	Tt
t	Tt	tt

Genotype ratios: 1:2:1 Phenotype ratios: 3:1

C. A short pea plant **cross-pollinates** with a heterozygous tall pea plant:

2 (Tt) : 2 (tt) : 0 (TT)

2 (tall) : 2 (short)

	t	t
T	Tt	Tt
t	tt	tt

Genotype ratios: 2:2:0 Phenotype ratios: 2:2

D. A homozygous tall pea plant **cross-pollinates** with a heterozygous tall pea plant:

2 (TT) : 2 (Tt) : 0 (tt)

4 (tall) : 0 (short)

	T	T
T	TT	TT
t	Tt	Tt

Genotype ratios: 2:2:0 Phenotype ratios: 4:0

genotype possibilities: FF, Ff, ff

phenotype possibilities: free earlobes, attached earlobes

Punnett Square Practice #2

Match the word with the correct definition. Write the letter in the blank provided. You will not use all the words.

E 1. Allele that is seen even if present with the recessive form.
M 2. Another word for egg and sperm cells.
C 3. Units of hereditary information (codes for one protein).
I 4. Two identical alleles for a trait.
G 5. The genetic make-up of an organism.
H 6. The physical characteristics of an organism.
K 7. When a plant fertilizes itself.
A 8. The passing of traits from parents to offspring.
J 9. Two different alleles for a trait.

A. Heredity
B. Chromosomes
C. Genes
D. Alleles
E. Dominant
F. Recessive
G. Genotype
H. Phenotype
I. Homozygous
J. Heterozygous
K. Self-pollination
L. Cross-pollination
M Gametes

10. Label the following genotypes as heterozygous or homozygous. Then indicate the phenotype for each genotype. Assume that **E** stands for large eyes and **e** stands for small eyes.

Genotype	Homozygous or Heterozygous	Phenotype
EE	homozygous (dominant)	large eyes
Ee	heterozygous	large eyes
ee	homozygous (recessive)	small eyes

11. Remember gametes only have **half** of the DNA as the body cells of an organism. What **alleles** would the **gametes** of an organism have given the following genotypes.

A. AA all gametes would have allele "A"

oops, repeat →

B. Aa 1/2 gametes would have allele "A", half would have "a"

~~C. Aa~~

D. AaBB (try this one!) gametes could have "AB" or "aB"

12. In humans, ~~having six fingers is dominant~~ to having five fingers. Using **T** and **t** to stand for the alleles, answer the following questions.

What is the ~~genotype~~ of a **heterozygous** human? Tt

What is the ~~phenotype~~ of a **heterozygous** human? 6 fingers

Think: Since this is true, why aren't there more humans with six fingers?

just because a trait is ~~dominant~~ dominant does not mean the allele is common in the population. The allele for having 6 fingers is likely an uncommon allele in humans.

13. Complete the following crosses using the punnett square method. Give the phenotype and genotype ratios for each cross. **F = Free earlobes** **f = attached earlobes**

A. Ff x ff

	F	f
f	Ff	Ff
f	Ff	Ff

G 4:0:0
P 4:0

B. Ff x Ff

	F	f
F	FF	Ff
f	Ff	ff

G 2:2:0
P 4:0

C. Ff x Ff

	F	f
F	FF	Ff
f	Ff	ff

G 1:2:1
P 3:1

D. Heterozygous free earlobes x attached earlobes

	F	f
f	Ff	ff
f	Ff	ff

G 2:2:0
P 2:2

14. In fruit flies, red (R) eye color is dominant over white (r) eye color. Use the punnett square method to determine the phenotype and genotype ratios for the following cross:

Heterozygous red eyes x white eyes

~~G 2(Rr):2(rr):0(RR)~~
~~P 2(red):2(white)~~

	R	r
r	Rr	rr
r	Rr	rr

15. In peas, a green pod (G) is dominant to a yellow pod (g). Use the punnett square method to determine the phenotype and genotype ratios for the following cross:

Heterozygous green pod x heterozygous green pod

	G	g
G	GG	Gg
g	Gg	gg

~~G 1(GG):2(Gg):1(gg)~~
~~P 3(green):1(yellow)~~

This is a test cross!

Punnett Square Practice #3 - Complex Crosses

1. In dogs, there is a hereditary deafness caused by a recessive gene, "d." A kennel owner has a male dog that she wants to use for breeding purposes if possible. The dog can hear, so ~~the owner knows his genotype is either DD or Dd~~. If the dog's genotype is Dd, the owner does not wish to use him for breeding so that the deafness gene will not be passed on. ~~This can be tested by breeding the dog to a deaf female (dd)~~. Draw the punnett squares to illustrate these two possible crosses. In each case, what percentage/how many of the offspring would be expected to be hearing? Deaf? ~~How could you tell the genotype of this male dog?~~

If any deaf offspring were produced after breeding male with a deaf female it would prove the male carried the recessive gene & had genotype "Dd"

Test #1

	d	d
D	Dd	Dd
D	Dd	Dd

100% hearing
0% deaf

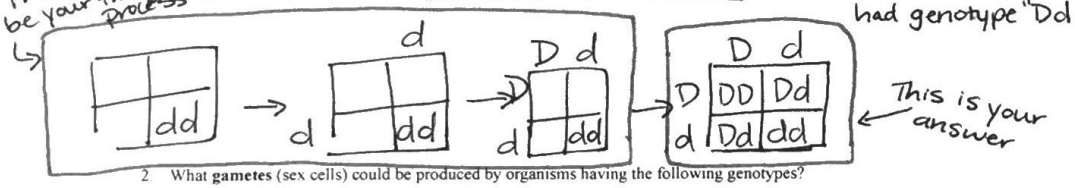
Test #2

	d	d
D	Dd	Dd
d	dd	dd

50% hearing
50% deaf

This should be your thought process

Using punnett square(s), show how two hearing dogs could produce deaf offspring.



This is your answer

2. What **gametes** (sex cells) could be produced by organisms having the following genotypes?
   a. AaBB "AB" or "aB"
   b. aaBB "aB" only
   c. Aabb "Ab" or "ab"
   d. AaBBCc (try this one!) "ABC", "ABc", "aBC", "aBc"

3. Use this information to fill out the following chart:

R - can roll tongue **F - free earlobes**
r - cannot roll tongue **f - attached earlobes**

Phenotype	Genotype
Cannot roll tongue with free earlobes	FFrr
Can roll tongue with free earlobes	FfRr
Heterozygous roller with attached earlobes	Rrff (or ffRr)
Can roll tongue with attached earlobes	RRff ; Rrff (or ffRR, ffRr)
Cannot roll tongue with heterozygous free earlobes	rrFf (or Ffrr)

the order you list the alleles does not matter!

4. For the following questions about dogs, use this information:

T - wiry coat texture **H - curly hair**
t - silky coat texture **h - straight hair**

   a. Give the genotype and phenotype ratios for this cross: TtHH x ttHH

	TH	tH
tH	TtHH	ttHH
tH	TtHH	ttHH

(G) 2(TtHH) : 2(ttHH)

(P) 2 (wiry : curly) : 2 (silky : curly)

   b. Give the genotype and phenotype ratios for this cross: TtHh x ttHh

	TH	Th	tH	th
tH	TtHH	TtHh	ttHH	ttHh
th	TtHh	Tthh	ttHh	tthh

(G) 1:2:1:1:2:1

(P) 3(wiry : curly) : 1(wiry : straight) : 3(silky : curly) : 1(silky : straight)

5. In fruit flies, having wings is dominant to being wingless and red eyes are dominant to sepia (brown) eyes. Show me how you would abbreviate each allele:

wings: W red eyes: R
wingless: w sepia eyes: r

*doesn't matter which letters you choose, but dominant alleles must be uppercase & recessive lowercase!

6. Using the allele abbreviations you just created, determine the **genotypic and phenotypic ratios** if you crossed a fruit fly purebred for having wings and heterozygous for red eyes with a fruit fly that is wingless and has sepia eyes:

WWRr x wwrr

	WR	Wr
wr	WwRr	Wwrr

(G) 1(WwRr) : 1(Wwrr)

(P) 1(wings : red) : 1(wings : sepia)

incomplete dominance = traits blend

example of multiple alleles

Punnett Square Practice #4 - Codominance, Incomplete Dominance, & Multiple Alleles

1. In Four O'Clocks, a breed of garden flower, the gene for red flowers (r) is incompletely dominant to the gene for white flowers (w). The heterozygous condition results in pink flowers. Show the results of a cross between a Four O'Clock with red flowers and a Four O'Clock with white flowers.

   a. Red Plant Genotype rr

   b. White Plant Genotype ww

   c. Are the F1 flowers (first set of offspring) purebred or hybrid?
   hybrid

   d. What is the phenotype of the F1 flowers?
   pink

	r	r
w	wr	wr
w	wr	wr

2. Now cross two individuals from the F1 generation. Show the cross.

   a. What are the possible genotypes of the offspring?
   ww, rr, wr

   b. What is the genotypic ratio?
   1:2:1

   c. What are the possible phenotypes?
   white, red, pink

   d. Phenotypic ratio?
   1:2:1

	w	r
w	ww	wr
r	wr	rr

3. A chicken that has speckled (white and black dots) feathers results when a black chicken is crossed with a white chicken. White chickens breed true; and black chickens breed true. Show the cross between two speckled chickens (use B and W).

   a. What is the probability that the chickens will have a speckled offspring?
   2/4 → 50%.

   b. What is the probability that the two speckled chickens will have a white offspring?
   1/4 → 25%

	B	W
B	BB	BW
W	BW	WW

We see both alleles at the same time → these alleles are codominant

4. In rabbits there are four different color alleles:
   C is dominant over all of the others
   c^{ch} is dominant to c^h and c
   c^h is dominant to c

   C = wild type color
   c^{ch} = chinchilla color
   c^h = himalayan color
   c = albino

   Each rabbit can have only two alleles. A wild colored rabbit is crossed with an albino and in the offspring there is a himalayan rabbit. Show the cross.

   a. What are the genotypes of the parents?
   Parent one Cc^{ch} Parent two cc

   b. What is the probability that they will have an offspring that is himalayan?
   2/4 → 50%.

   c. What is the probability that they will have an offspring that is albino?
   0/4 → 0%.

   d. What is the probability that they will have an offspring that is wild colored?
   2/4 → 50%.

	C	c^{ch}
c	Cc	cc^{ch}
c	Cc	cc^{ch}

5. In a cross between two himalayan rabbits, some albino offspring appear. Show the cross.

   a. What is the probability that they will have an offspring that is albino?
   1/4 → 25%.

   b. What percent of their offspring would be true breeding himalayans?
   1/4 → 25%.

	c^h	c
c^h	c^hc^h	c^hc
c	c^hc	cc

6. In a cross between a wild rabbit an a chinchilla rabbit, there are some himalayan rabbits. Show the cross:

   a. What is the probability that they will have a himalayan offspring?
   1/4 → 25%.

   b. What is the probability that they will have a chinchilla offspring?
   1/4 → 25%.

	C^{ch}	c
C	Cc^{ch}	Cc
c^h	$c^{ch}c^h$	c^hc

genotypes could be $c^{ch}c^{ch}$ or $c^{ch}c^h$ or Cc for your cross!

7. In pigeons, there are different feather color alleles:
   B^A is dominant over all the others; B is dominant to b
   Each pigeon can only have two alleles

   B^A = ash-red colored feathers
   B = wild-type blue feathers
   b = chocolate colored feathers

   Show the cross between a pigeon with blue feathers and a pigeon with ash-red feathers. Some of the offspring have chocolate feathers.

   a. What is the probability that they will have an offspring with ash-red colored feathers? 2/4 → 50%.

   b. What is the probability that they will have an offspring with chocolate colored feathers?
   1/4 → 25%.

	B	b
B^A	B^AB	B^Ab
b	Bb	bb