## ALE 8x: Genetics Practice Problems

## Please Take Note.....

- There is a list of genetic terms and definitions on page 8 that you may find useful.
- The following six problems sets are for your practice (and enjoyment too!) and will not be collected for stamping or grading, but you will be tested on similar kinds of questions.
- Once you become proficient at solving a certain kind of problem, go on to another kind-don't spend a lot of time solving problems that are easy for you to do-go on to those that are more challenging!


## Practice Problem Set I: Making Gametes and Using the Probability Method

1. How many different types of gametes could be generated from individuals with the following genotypes?
A) AaBb 4
B) AaBbCc
8
C) AaBbCcDd
2. How many different types of gametes could be generated from individuals with the following genotypes?
A) AABBCc 2
B) AaBBCC 2
C) AABbCC 2
3. How many different types of gametes could be generated from individuals with the following genotypes?
A) AABbCc 4
B) AaBbCC
4
C) AaBBCc
4
4. Given AaBbcc x AabbCc. What are the chances of producing the following genotypes?
A) $\mathrm{AaBbCc} \quad 1 / 8$
B) aabbcc
1/16
C) AABbCC
0
5. Given $\mathrm{AaBbCC} x$ aabbCc what are the chances of producing the following genotypes?
A) AabbCC
1/8
B) aaBBCc 0
C) aabbcc 0
6. Given the following $\mathrm{AaBbCcDD} \times \mathrm{AAbbcc} \mathrm{Dd}$ what would be the chances of producing
A) AabbccDD $1 / 16$
B) AabbccDD 1/16
C) $\mathrm{AABbCcDd} 1 / \mathbf{1 6}$
7. Suppose $\mathrm{A}=$ Red and $\mathrm{a}=$ White. $\mathrm{B}=$ Tall and $\mathrm{b}=$ Short. Given the following cross $\mathrm{AaBb} \times \mathrm{aaBb}$ what are the chances of producing the following phenotypes?
A) Red Tall $\mathbf{3 / 8}$
B) Red Short
1/8
C) White Short $1 / 8$
8. Suppose $\mathrm{A}=$ Red, and $\mathrm{a}=$ White; $\mathrm{B}=$ Tall, and $\mathrm{b}=$ Short; $\mathrm{C}=$ Round seed, and $\mathrm{c}=$ wrinkle seed. Given the cross of AaBbcc x AabbCc what are the chances of producing the following phenotypes?
A) Red, Tall, and Round Seed $\mathbf{3 / 1 6}$
B) White, Short, and Wrinkled Seed $\mathbf{1 / 1 6}$
C) Red, Short and Wrinkled Seed 3/16
9. Suppose you cross a heterozygous red, homozygous tall, heterozygous round seed with a homozygous white, heterozygous tall, homozygous wrinkled seed, what would be the chances of producing the following: (Assume dominance is the same as question 8)
A) Red, Tall, Round Seed $\mathbf{1 / 4}$
B) Homozygous red, Homozygous tall, heterozygous wrinkled $\mathbf{0}$
C) Heterozygous red, Heterozygous tall, Heterozygous wrinkled 0

## Genetics Practice Problem Set 2: Monohybrid Crosses

1. Assume that hair color in humans is determined by a single gene as follows:

BB individuals have black hair; Bb have brown hair; and bb have blonde hair.
a) If two brown hair people marry, what is the probability that their first child will have brown hair? $\mathbf{5 0 \%}$
b) Assume that their first child did have black hair. What is the probability that the next child will also have black hair? 25\%
2. a) A red tomato plant is self-fertilized. $25 \%$ of the offspring are green. What is the genotype of the parent? (Indicate the genotype and dominant allele.)

Heterozygous, $\mathbf{R r}$; Where: $\mathbf{R}=$ Red, $\mathbf{r}=$ green
b) If a plant heterozygous for the red/green alternative alleles is crossed to another tomato plant and all the progeny are red, what is the genotype of the second plant?

## Homozygous dominant, RR

c) In a cross between a red tomato plant and a green tomato plant, if $50 \%$ of the progeny (offspring) are red and $50 \%$ are green, what are the genotypes of the two parents?.

## $\mathbf{P}$ : Rr $\mathbf{x} \mathbf{r r}$

3. In cattle the polled (hornless) trait is dominant and is determined by the dominant gene D . The horned trait is recessive. A certain polled bull is mated to three cows.
Cow A, which is horned, gives birth to a polled calf. Cow B, also horned, produces a horned calf. Cow C, which is polled, produces a horned calf. What are the genotypes of the four parents?
Bull: Dd
Cow A: dd
Cow B: dd
Cow C: Dd
4. In summer squash, white fruit color is dominant; yellow is recessive.
a) If a squash plant that is homozygous for white is crossed with a homozygous yellow, what will be the phenotype of the F1 generation?

Aa where: $A=$ white, $\mathbf{a}=$ yellow
b) What phenotypes and their fractional amounts would be expected in the F2 generation?
$3 / 4$ white, $1 / 4$ yellow
c) What would be the appearance of the offspring of a cross between an F1 individual and a homozygous yellow individual? (include the fractional amounts of each type )
$1 / 2$ white, $1 / 2$ yellow
d) What is the name of the type of cross that was performed in c ?

Test Cross
5. Lithuanian lima beans have inflated pods, but you have discovered a mutant variety with flat pods (how exciting!!!). If flat pod is determined by a recessive gene, what phenotypes and their fractional amounts would be expected in the F1 and the F2 of a cross between a true breeding flat and a true breeding inflated?

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I = Inflated; i = flat
F
F2: 3/4 Inflated, 1/4 flat
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## Genetics Practice Problem Set 3: Dihybid and Sex-Linked Crosses

1. In the land of Magumba there grows the fabled Bungula. In Bungulas, Red Fur color, A, is incompletely dominant over Purple Fur, a, the heterozygous condition being Green Fur. Long Wings, B, are dominant over short wings, b.
a. If a pure breeding Red, short-winged Bungula is mated with a pure breeding Purple, long-winged one, what will be the Phenotypes and their expected occurrences in the F1 generation?

## $F_{1}: 100 \%$ with Green fur - Long wings

b. What will be the phenotypes and their expected occurrences in the F2?

Red fur - Long wings: 3/16
Green fur - Long wings: $6 / 16$ or $3 / 8$
Red fur - Short wings: $\mathbf{1 / 1 6}$
Green fur - Short wings: $2 / 16$ or $\mathbf{1 / 8}$
Purple fur - Long wings: 3/16
Purple fur - Short wings: 1/16
2. In Drosophila (fruit fly) yellow body color is sex linked --- yellow is recessive to normal body color. If a yellow bodied female is crossed with a normal male and (a) an F1 female from this cross is mated with her father and (b) an F1 male is mated with his mother, what will be the phenotypes (as to body color) and their expected occurrences in the offspring of cross (a) and cross (b)? Don't Panic! State results for the two sexes separately.
a. Cross in question: $X^{N} X^{n} \quad \mathbf{X} \quad X^{N} Y \rightarrow$

50\% offspring: Normal Females (half of which are carriers)
25\% offspring: yellow males
25\% offspring: Normal males
b. Cross in question: $X^{n} X^{n} x X^{n} Y \rightarrow 50 \%$ of offspring: yellow bodied females 50\% offspring: yellow bodied males

1. What are the possible blood types of the children in the following families?
a. Mother: Type A blood and Father: Type A.

Possible blood types of children: A and $O$
b. Mother: Type B blood and Father: Type AB.

Possible blood types of children: A, B and AB
c. Mother: Type A blood and Father: Type O.

Possible blood types of children: A and $O$
2. A mother has Type $\mathrm{A}, \mathrm{Rh}$ - blood and the father has $\mathrm{A}, \mathrm{Rh}+$ blood.
a. What are all the possible genotypes of the offspring these two could produce?

Possible genotypes of children: $I^{A} I^{A} R r \quad I^{A} I^{A} r r \quad I^{A} \mathbf{i R r} \quad I^{A}$ irr $\quad$ iiRr $\quad$ iirr
Where: $\quad I^{A}=$ type $A$ allele; $\mathbf{i}=$ type $\mathbf{O}$ allele; $\quad \mathbf{R}=\mathbf{R h}$ positive allele; $\mathbf{r}=\mathbf{R h}$ negative allele
b. What are all the possible phenotypes of their potential offspring?

Possible blood types of children: A+, A-, $\mathrm{O}+$, and $\mathrm{O}-$
3. A mix-up happened in the maternity ward of a hospital. Baby A (Blood type A) and Baby B (Blood type O) lost there ID tags!! If the suspected parents have the following blood types, match the babies with the correct parents.
Couple 1: Type B and Type A; Couple 2: Type A and AB

Baby B could belong to couple 1 or couple 2, but baby B can't belong to couple 2. Therefore....
Baby A belongs to couple 2 and Baby B belongs to couple 1.
4. A mother has Type AMRh- blood and the father has ANRh+ blood
a. What are all the possible genotypes of the offspring these two could produce?

Possible genotypes of offspring:
$\mathbf{I}^{\mathbf{A}} \mathbf{I}^{\mathbf{A}} \mathbf{M N R r}$, $\mathbf{I}^{\mathrm{A}} \mathbf{I}^{\mathrm{A}} \mathbf{M} \mathbf{N r r}, \mathbf{I}^{\mathbf{A}} \mathbf{i M N R r}$, $\mathbf{I}^{\mathbf{A}} \mathbf{i M N r r}$, iiMNRr, iiMNrr
b. What are all the possible phenotypes of their potential offspring? AMNRh+, AMNRh-, OMNRh+, OMNRh-

## Genetics Practice Problem Set 5

## Crossing over, Linkages, and Independent Assortment

For problems 1-6 assume the following allelic relationships exist in fruit flies:

- Normal body ( N ) is dominant to fat body (n).
- Red eyes (R) is dominant to purple eyes (r).
- Straight wings (S) is dominant to curved wings (s).
- Long legs (A) is dominant to short legs (a).
- Yellow body color (B) is dominant to black body color (b).
- Long feelers ( F ) is dominant to short feelers (f).

Use this information about genes in fruit flies to decide whether the given crosses and their results given below represent:
A. Crossing Over.
B. Linkage.
C. Sex Linkage.
D. Independent Assortment.

1. Crosses between flies with genotype NnRr and flies with genotype nnrr produce offspring as follows: B
$50 \%$ normal body, red eyes
$50 \%$ fat body, purple eyes
2. Offspring from the cross RrSs x rrss were: D

| $25 \%$ red eyes, straight wings | $25 \%$ purple eyes, straight wings |
| :--- | :--- |
| $25 \%$ red eyes, curled wings | $25 \%$ purple eyes, curled wings |

3. Offspring from the cross AaSs $x$ aass were: B

50\% short legs, straight wing
$50 \%$ long legs, curled wing.
4. Given what you know from the cross results in problem one ( NnRr x nnrr) what would be illustrated if that same cross yielded the following results: A

$$
\begin{array}{ll}
49 \% \text { normal body, red eyes } & 1 \% \text { normal body, purple eyes } \\
49 \% \text { fat body, purple eyes } & 1 \% \text { fat body, red eyes }
\end{array}
$$

5. A black female is mated to a yellow male results in: D
$\begin{array}{ll}25 \% \text { yellow females } & 25 \% \text { black females } \\ 25 \% \text { yellow males } & 25 \% \text { black males }\end{array}$
6. A female with long feelers is mated to a male with long feelers resulting in: $\mathbf{C}$
females: $100 \%$ with long feelers
males: $50 \%$ with long feelers and $50 \%$ with short feelers.

## 3. POLYDACTYLY (Six Fingers) (Use B and b ) Autosomal Dominant


4. MUSCLE ATROPHY (Use A and a) Autosomal Recessive

 Generation IV:


