Part 1: Terms

Genetics

Heredity

Chromosome

Gene

Trait

Allele

Purebred

Hybrid

Probability

Meiosis

Diploid

Haploid

Fertilization

Part 2: Crosses
(include P1 and P2, types of gametes, possible combinations table, Punnett square, and the genotype/phenotype ratio of F1)

Simple monohybrid crosses

1. In guinea pigs, long hair is dominant to short hair. A pure bred short haired guinea pig is bred with a hybrid long haired.
2. Tongue-curling in humans is a dominant genetic trait. Suppose a man who is **Tt** for tongue-curling marries a woman who is also **Tt** for this trait.

Sex linked traits

3. Use a Punnett square to demonstrate the probability of two parents having a male or female offspring
4. In fruit flies, eye color is sex linked where red eyes are dominant to white eyes. Show the cross of a red eyed female (heterozygous) and a white eyed male.

Incomplete dominance

5. In radishes, red and white are pure-breeding colors, while hybrids are purple. If a red radish plant is crossed with a white radish plant, describe the F1 and the F2 generation.

Co-Dominance

6. If a woman who is heterozygous A has a child with a man who is heterozygous B, describe the offspring.
7. In cats, the gene for calico (multicolored) cats is codominant and sex linked. Females that receive a B and an R gene have black and orange splotches on white coats. Males can only be black or orange, but never calico. Cross a calico female cat with a black male and describe the offspring.

Dihybrid crosses

8. A tall green pea plant (TTGG) is crossed with a short white pea plant (ttgg). The F1 generation is then self-fertilized. Describe both the F1 and F2 generations.

Part 3: ABO blood typing

9. A person is blood type A:
    a. What is (are) the possible genotypes?
    b. What antigens do they have on their red blood cells?
    c. What antibodies are in the plasma of their blood?
    d. Who can they donate to?
    e. Who can they receive blood from?

10. What blood type is considered the universal donor and why?

11. What blood type is the universal recipient and why?

Genetics - the study of heredity

heredity - the characteristics that are transmitted from parents to their offspring

Chromosome - consists of a molecule of DNA, along with various proteins, that carry the genes that determine heredity

gene - a segment of DNA that codes for an inherited trait

trait - a characteristic of an organism

allele - possible forms of a gene

purebred - homozygous, both alleles for a trait are the same

hybrid - heterozygous, both alleles for a trait are different

meiosis - the process of cell division in which haploid gametes are produced

Diploid - having two sets of chromosomes

haploid - having one set of chromosomes

fertilization - union of two haploid gametes to produce a diploid zygote

1) H - long hair
h - short hair

genotype	phenotype
HH - homozygous dom.	long hair
Hh - heterozygous	long hair
hh - homozygous rec.	short hair

P1 hh × P2 Hh

gametes: h and h H and h

	h	h
H	Hh	Hh
h	hh	hh

genotype: $\frac{1}{2}$ heterozy. $\frac{1}{2}$ homozy rec.

phenotype: $\frac{1}{2}$ long hair $\frac{1}{2}$ short hair

2) T - tongue roll
t - no tongue roll

genotype		phenotype
TT	homozy dom	roll
Tt	heterozy.	roll
tt	homozy rec.	no roll

P1 Tt × Tt

gametes: T and t T and t

	T	t
T	TT	Tt
t	Tt	tt

genotype: $\frac{1}{4}$ homozy dom.
$\frac{2}{4}$ heterozy.
$\frac{1}{4}$ homozy rec.

phenotype: $\frac{3}{4}$ tongue roll
$\frac{1}{4}$ no tongue roll

3) $XX \times XY$

	X	X
X	XX	XX
Y	XY	XY

50% chance of female

50% chance of male

4) R. red

r — white

genotype phenotype

X^RX^R · homoz. dom. female · red eyed female

X^RX^r · heterog female · red eyed female

X^rX^r · homoz rec. female · white eyed female

X^RY dom. male · red eyed male

X^rY rec. male · white eyed male

$X^RX^r \times X^rY$

gametes X^R + X^r X^r + Y

	X^R	X^r
X^r	X^RX^r	X^rX^r
Y	X^RY	X^rY

genotype: $\frac{1}{4}$ heterog female

$\frac{1}{4}$ homo. rec female

$\frac{1}{4}$ dom. male

$\frac{1}{4}$ rec. male

phenotype: $\frac{1}{4}$ red eyed female $\frac{1}{4}$ white eyed female

$\frac{1}{4}$ red eyed male $\frac{1}{4}$ white eyed male

5. R - red
W - white

genotype	phenotype
RR	homoz R	red
RW	heteroz	purple
WW	homoz W	white

P1 RR × WW
gamete: R + R W + W

	R	R
W	RW	RW
W	RW	RW

genotype: 100% heteroz
phenotype: 100% purple

F1 RW × RW
gamete: R + W R + W

	R	W
R	RR	RW
W	RW	WW

genotype: $\frac{1}{4}$ homoz R
$\frac{2}{4}$ heteroz
$\frac{1}{4}$ homoz W
phenotype: $\frac{1}{4}$ red: $\frac{2}{4}$ purple: $\frac{1}{4}$ white

7. B - black
R - orange

genotype	phenotype
X^BX^B	homoz dom female	black female
X^BX^R	heteroz female	calico female
X^RX^R	homoz rec female	orange female
X^BY	dom male	black male
X^RY	rec. male	orange male

$X^BX^R \times X^BY$
gamete: $X^B + X^R$ $X^B + Y$

	X^B	X^R
X^B	X^BX^B	X^BX^R
Y	X^BY	X^RY

genotype: $\frac{1}{4}$ homoz R fem $\frac{1}{4}$ heteroz female $\frac{1}{4}$ black male $\frac{1}{4}$ orange male
phenotype: $\frac{1}{4}$ black fem $\frac{1}{4}$ calico fem. $\frac{1}{4}$ black male $\frac{1}{4}$ orange male

b)

genotype	phenotype
AA homozA	A
AO heteroA	A
BB homozB	B
BO heteroB	B
AB heteroAB	AB
OO homozO	O

P1 AO × BO

gamet: A + O B + O

	A	O
B	AB	BO
O	AO	OO

genotype: $\frac{1}{4}$ heteroAB $\frac{1}{4}$ heteroB $\frac{1}{4}$ heteroA $\frac{1}{4}$ homozO

phenotype: $\frac{1}{4}$ AB $\frac{1}{4}$ B $\frac{1}{4}$ A $\frac{1}{4}$ O

8) T - tall G - green
t - short g - white

P1 TTGG × P2 ttgg

trait 1

Tt × tt

	T	T
t	Tt	Tt
t	Tt	Tt

phenotype: 100% tall

trait 2

Gg × gg

	G	g
g	Gg	gg
g	Gg	gg

100% green

100% tall and green

F1 TtGg × TtGg

trait 1

	T	t
T	TT	Tt
t	Tt	tt

trait 2

	G	g
G	GG	Gg
g	Gg	gg

$\frac{9}{16}$ tall/green $\frac{3}{16}$ tall, white $\frac{3}{16}$ short green $\frac{1}{16}$ short, white

9. a) AA or AO

b) A antigens

c) B antibodies

d) anyone without A antibodies
A or AB

e) anyone without B antigens
A or O

10. The universal blood donor is
O because there are no
antigens on the red blood cells

11. The universal blood recipient is
AB because they have no
antibodies in the plasma of
their blood