Chromosome – DNA and protein tightly wound together
Karyotype – picture of the chromosomes
Diploid – chromosomes in pairs (2N) (46 for humans)
Haploid – 1 of each chromosome pair (N) (23 for humans) (Ex: egg, sperm, pollen)
Girl XX, Boy XY
Probablility = number of one kind of outcome / Total number possible
Allele – form of a gene
Dominant – always shows up if present (T)
Recessive – will only show up if dominant is not present (t)
Homozygous – 2 of the same alleles (TT or tt)
Heterozygous – 2 different alleles (Tt)
Phenotype – physical characteristics (Tall)
Genotype – genetic make-up (Tt)

Gregor Mendel: Austrian monk who crossed (x) pea plants

TT X tt (P generation - parents)

	T	T
t	Tt	Tt
t	Tt	Tt

F_1 (First filial generation)
Genotype: Tt 100%
Phenotype: Tall 100%

	T	t
T	TT	Tt
t	Tt	Tt

F_2 (Second filial generation)
Genotype: TT ¼
Tt 2/4 = ½
tt = ¼
Phenotype: Tall ¾
Short ¼

Test cross – crossing an unknown (RR or Rr) with a homozygous recessive
Red eyed fruit fly

RR X rr

	R	R
r	Rr	Rr
r	Rr	Rr

Phenotype: 100% red eyed

Rr X rr

	R	r
r	Rr	rr
r	Rr	rr

Phenotype: ½ red
½ white

In Labrador retriever dogs, a black coat is a dominant characteristic while a chocolate coat (brown) is recessive. What are the genotype and phenotype percentages of the F_1 generation if the male is homozygous dominant black and the female is homozygous recessive chocolate?

B-black, b- brown BB X bb

	B	B
b	Bb	Bb
b	Bb	Bb

Genotype: Bb 100%
Phenotype Black 100%

In pintail ducks, normal feathers have a dull appearance, while silky feathers have a shine to them. Normal feathers are dominant over silky feathers. A pintail drake (a male duck), heterozygous dominant for normal feathers, mates with a pintale female, homozygous recessive for silky feathers. What kind of feathers will their ducklings have?

N – normal, n – silky Nn X nn

	N	n
n	Nn	nn
n	Nn	nn

Genotype: Nn ½
Nn ½
Phenotype: Normal ½
Silky ½

Hardy-Weinberg – measures the frequency of alleles; gene frequencies in randomly breeding populations remain constant from generation to generation.
p=%A q=%a
$p+q = 1$ and $p^2 + 2pq + q^2 = 1$
AA Aa aa

For example, tasting PTC is dominant. Tasters (p^2+ 2pq) in North America would be 0.55
Nontasters (q^2) in North America would be 0.45

q^2=0.45, so $\sqrt{q^2}$=q =0.67
p+q=1, p+.67=1, p=.33

p^2=.10 = TT
2pq=2(.33)(.67)=.44 - Tt
q^2=.45=tt

Albinism is a rare genetic inherited trait that is only expressed in the phenotype of homozygous recessive individuals (aa). The most characteristic symptom is a mared deficiency in the skin and hair pigment melanin. This condition can occur among any human group as well as among other animal species. The average human frequency of albinism in North America is only aobut 1 in 20,000. What is the frequency of the heterozygous genotype (Aa)?
[Answer: 1.4%]

1 in 1700 US Caucasian newborns have cystic fibrous. C for normal is dominant over c for cystic fibrosis. What is the frequency of the heterozygous genotype (Cc)? It has been found that a carrier (Cc) is better able to survive diseases with severe diarrhea. What would happen to the frequency of the "c" if there was an epidemic of cholera or other type of diarrhea producing disease?
[Answer: 4.68%, the frequency would increase]

If 9% of an African population in born with a severe form of sickle-cell anemia (ss), what percentage of the population will be more resistant to malaria because they are heterozygous (Ss) for the sickle-cell gene?
[Answer: 42%]

Dihybrid problems – looking at two traits at once (AaMm X AaMm)

FOIL (first, outer, inner, last): AM, Am, aM, am

	AM	Am	aM	am
AM	AAMM	AAMm	AaMM	AaMm
Am	AAMm	AAmm	AaMm	Aamm
aM	AaMM	AaMm	aaMM	aaMm
am	AaMm	Aamm	aaMm	aamm

Genotype:
AAMM 1/16
AAMm 2/16
AaMM 2/16
AaMm 4/16
AAmm 1/16
Aamm 2/16
aaMM 1/16
aaMm 2/16
aamm 1/16

Phenotype:
AM 9/16
Am 3/16
aM 3/16
am 1/16

RATIO: 9:3:3:1

In Rock Cornish game fowl, red feathers are dominant over white feathers and a crested-comb is dominant over a plain comb. A red rooster impregnates a white hen. The rooster is homozygous dominant for color and has a plain comb. The hen has a crested-comb and is heterozygous dominant for this trait. What will the phenotype of the brood look like? [Answer: ½ red/crested, ½ red/plain]

In humans, a type of blindness called aniridia and migraine headaches are both domniant to the normal traits. What are the odds that two people both suffering from aniridia and migraines would be able to produce a child that is genetically free from either disease if;

a) both parents are homozygous dominant for both traits? [Answer: 0%)
b) Both parents are heterozygous dominant for both traits? [Answer: 1/16]
c) The father is heterozygous dominant for both traits and the mother is homozygous dominant for both traits? [Answer: 0%]

In *Drosophilia melanogaster*, the common fruit fly, red eyes and straight wings are dominant traits while white eyes and curved wings are recessive traits. A male fly is homozygous recessive white-eyed and heterozygous dominant straight-winged. A female fly is heterozygous dominant red-eyed and heterozygous dominant straight-winged. If these two flies mate, what will be the phenotype ratio of their offspring? [Answer: red/straight 1/8, white/straight 1/8, red/curved 1/8, white/curved 1/8]

Multiple Alleles – more than two allele options for a particular trait

Example: Blood type (O is recessive, A and B are dominant)

AA X BO

	A	A
B	AB	AB
O	AO	AO

Genotype: ½ AB, ½ AO

Phenotype: ½ AB blood, ½ A blood

AB X OO

	A	B
O	AO	BO
O	AO	BO

Genotype: ½ AO, ½ BO

Phenotype: ½ A blood, ½ B blood

Codominance (Incomplete dominance) – heterozygous individuals show a blended phenotype

Example: Snap dragons (red=RR, white=rr, pink=Rr)

	R	r
R	RR	Rr
r	Rr	rr

Genotype: ¼ RR, ½ Rr, ¼ rr

Phenotype: ¼ Red, ½ pink, ¼ white

Sex-linked disorders – those disorders carried on the X chromosome. Males are more likely to display the trait because they only have one X.

Example: Hemophilia

	X^H	X^h
X^H	$X^H X^H$	$X^H X^h$
Y	$X^H Y$	$X^h Y$

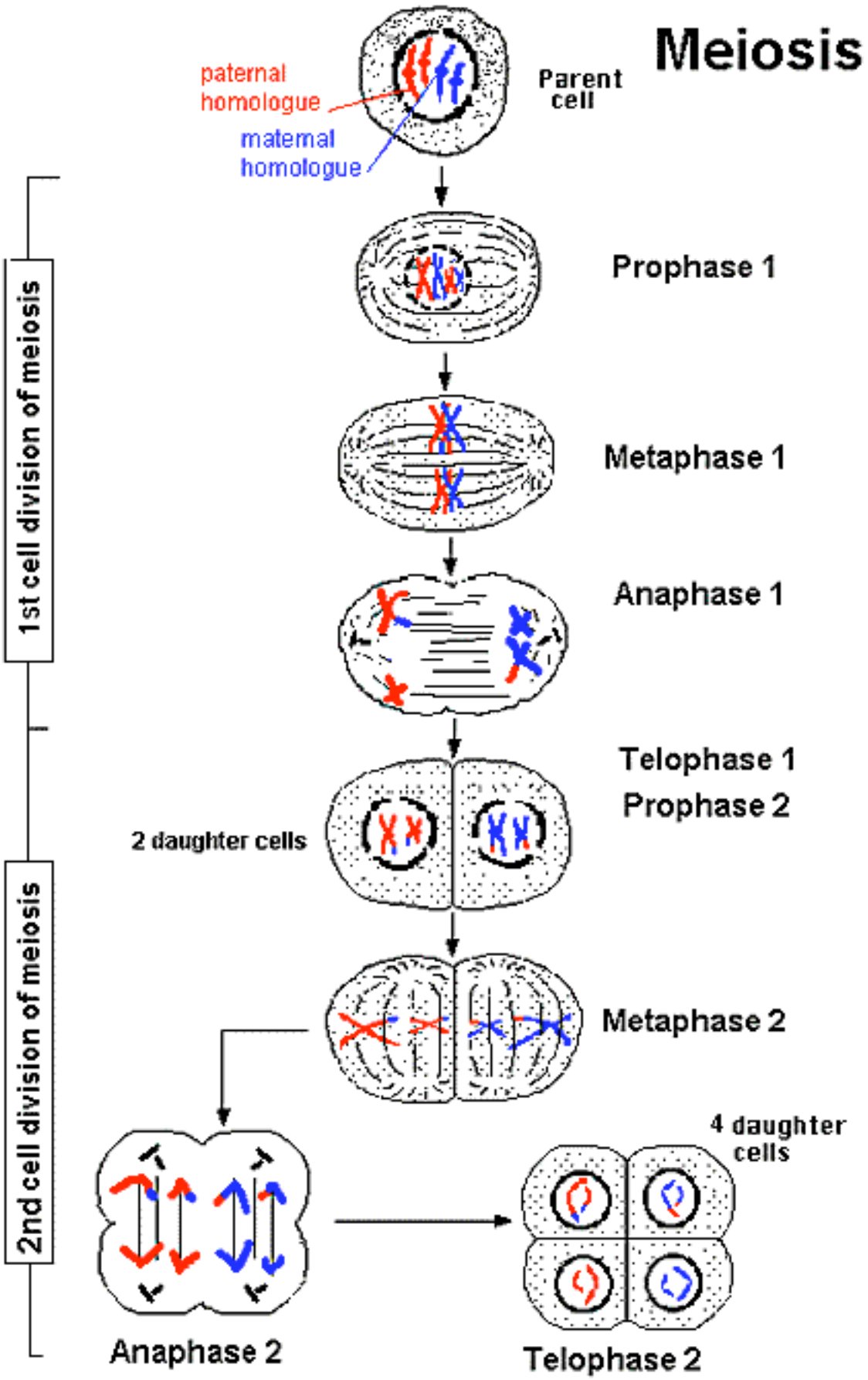
Phenotype: ½ - normal female, ¼ - normal male, ¼ - hemopheliac male

Example: Color blindness

	X^c	X^c
X^C	$X^C X^c$	$X^C X^c$
Y	$X^c Y$	$X^c Y$

Phenotype: ½ - normal female (carriers), ½ -color blind males

Meiosis – division of cells ONLY in ovaries and testes to make gametes (egg, sperm, pollen)


Meiosis
paternal homologue
maternal homologue
Parent cell
Prophase 1
Metaphase 1
Anaphase 1
Telophase 1
Prophase 2
2 daughter cells
Metaphase 2
4 daughter cells
Anaphase 2
Telophase 2
1st cell division of meiosis
2nd cell division of meiosis