Key!

Science 30 Unit A: Biology

Inheritance

Today, you will:

- explain, with the aid of Punnett squares, the inheritance of single traits by applying current understanding of the gene, segregation and dominance.

- distinguish autosomal from sex-linked patterns of inheritance

- investigate, with the aid of a pedigree chart, the familial inheritance of a specific trait that is controlled by a single pair of genes

- predict, quantitatively, the probability of acquiring a particular trait in autosomal and sex-linked patterns of inheritance.

Diploma Question Alert!

Use the following information to answer the next question.

Some Structures of the Circulatory System

1 Aorta
2 Lung capillaries
3 Left side of the heart
4 Right side of the heart

Numerical Response

1. Antibiotics are used to help the body fight infections. When an antibiotic is injected into a vein in a person's arm, the sequence in which it will travel through the structures listed above is ____, ____, ____, and ____.

(Record all four digits of your answer in the numerical-response section on the answer sheet.)

4231

Ans:

Diploma Question Alert!

2. When an injection is given, bleeding may occur at the injection site. Blood clotting is initiated by

A. T cells
B. platelets
C. red blood cells
D. white blood cells

Ans:

Diploma Question Alert!

Use the following information to answer the next question.

Some Immune Responses

1 B cells produce antibodies.
2 Helper T cells identify markers.
3 Antibodies attach to foreign proteins.
4 Macrophages present antigen markers.

Numerical Response

3. When the human immune system is invaded by a particular virus for the first time, it responds by employing the immune responses listed above in the sequence ____, ____, ____, and ____.

(Record all four digits of your answer in the numerical-response section on the answer sheet.)

Ans:

omit for COVID-19

Diploma Question Alert!

Use the following information to answer the next question.

A variety of cell processes occur during growth and reproduction.

Some Cell Processes

1 Meiosis
2 Mitosis
3 Fertilization

Numerical Response

2. Match the cell processes numbered above with the descriptions of processes given below. (Processes may be used more than once.)

Process: Description:	Forms gametes	Combines genetic information from two parents	Responsible for growth and development	Divides genetic information into half the original amount
	1	3	2	1

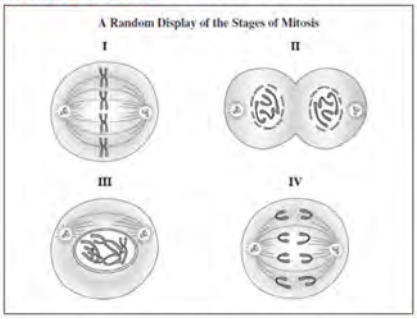
Ans:

(Record all four digits of your answer in the numerical-response section on the answer sheet.)

Diploma Question Alert!

information to answer the next question.

A Random Display of the Stages of Mitosis



3. Cells in an implanted embryo undergo the process of mitosis as the embryo develops. The correct order for the stages of mitosis shown above is

A. I, II, III, IV
B. I, III, IV, II
C. III, I, II, IV
D. III, I, IV, II

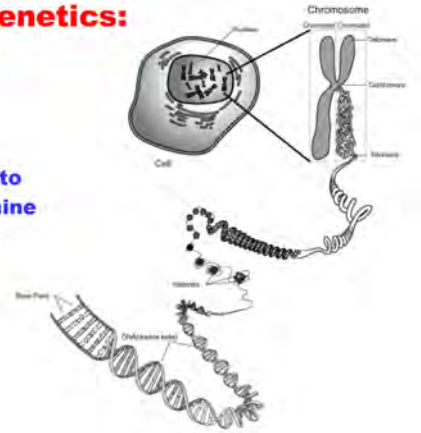
Ans:

Review of Genetics:

DNA carries your genetic information...

DNA is grouped into genes that determine particular traits...

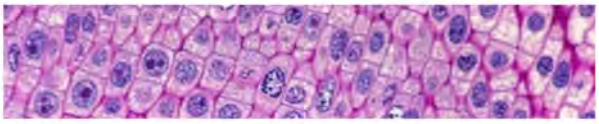
genes group together to form chromosomes.



ALMOST every cell in your body has 46 chromosomes (bunched into 23 pairs). These are called diploid cells.

These cells are the autosomal cells of your body, the ones that just clone themselves over and over again using mitosis.

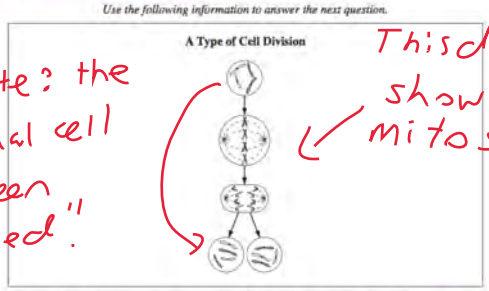
ex) Skin cells, muscle cells, etc



Diploma Question Alert!

Use the following information to answer the next question.

A Type of Cell Division



Note: the original cell has been "cloned".

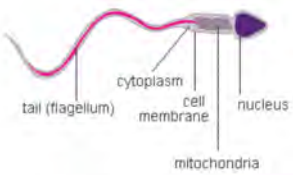
This diagram shows mitosis

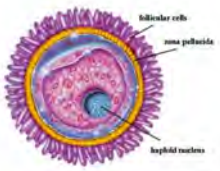
7. The change in chromosomal content from the parent cell to the daughter cells, as illustrated above, can be described as

A. $4n \rightarrow n$
B. $4n \rightarrow 2n$
C. $2n \rightarrow 2n$
D. $2n \rightarrow n$

Ans:

But, there are two cells that have only 23 chromosomes: only half the genetic materials (haploids): the sperm and the egg.





These cells are called *gametes*. And they're the ones we focus on today.

Today, we will see how particular genes give particular traits in offspring by examining the genetics of the parents.

This all starts when fertilization occurs.

Here, the gametes meet and exchange genetic information from the mother and father.

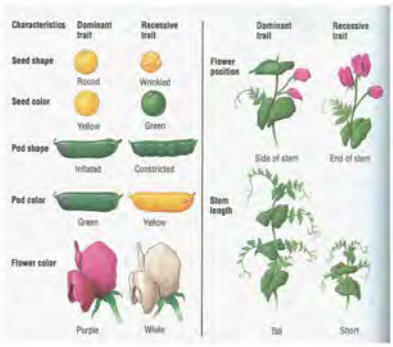
What's the result of this sharing of genetic info? That's a question that has been pondered for a long time.

Gregor Mendel (1822-1884) worked with garden peas to study the results of the genetic info swap.

He noticed that traits in peas (colour, size, etc) were not blends of the parents, but instead they displayed dominance.

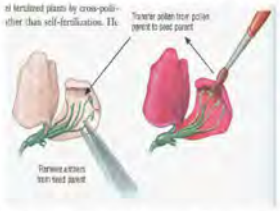
Figure 20.2
Gregor Mendel was an Austrian monk whose experiments with garden peas laid the foundation for the science of genetics.

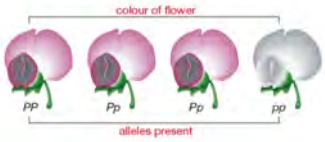
Mendel noticed that some traits in peas (like being round instead of wrinkled) occurred more often, and that if a round pea and wrinkled pea were mixed, most of the time round peas were the result.



He called the common traits *dominant* and the less common traits *recessive*.

Mendel cross-pollinated two flowers from two different peas. He was combining different sets of haploids to fertilize a new pea!



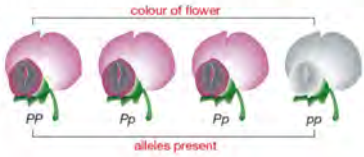


He got different varieties of pea produced in the offspring, some matching the parents, some not matching.

So, what was causing dominance and recessiveness?

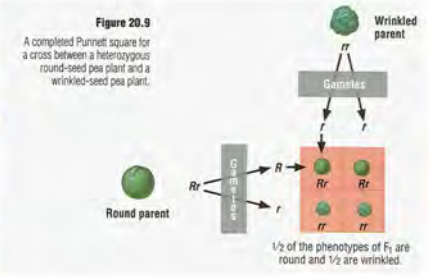
It was tricky, because some traits might disappear after one generation, but reappear 1/4 of the time in the second generation.

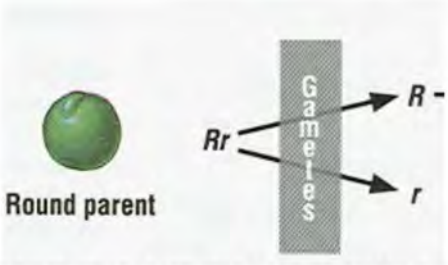
He realized that all of the peas contained the all of the possible combinations of traits (called alleles), but that some we physically expressed, while others were masked.



Mendel said that if the alleles are known, one can predict the likely visible traits produced (these are called phenotypes).

This is all kept track of with letters (upper case indicating dominant, lower case recessive) and a grid called a Punnett square.





Note: remember how earlier we talked about diploids and haploids? This graphic shows the split occuring during meiosis from a full set of genetic info into half a set. This process of splitting is called segregation.

So, let's use the example of round vs. wrinkled peas.

Characteristics	Dominant trait	Recessive trait
Seed shape	Round	Wrinkled

Being round is a dominant trait. We'll call round "R". It "beats out" being wrinkled, which is recessive. We'll call that "r".

There are three ways to end up a round pea:

A round allele from Dad and round allele from Mom

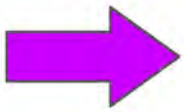
A round allele from Dad and a wrinkled from Mom

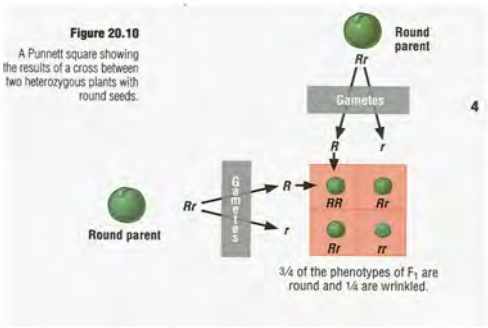
A wrinkled allele from Dad and a round from Mom

There's only one way to end up wrinkled: if both recessive alleles get together.

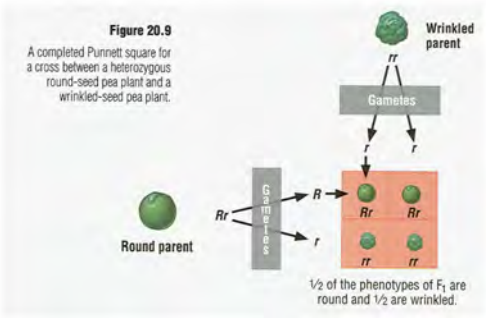
These combinations of letters are called genotypes.

The completed Punnett square diagram looks like this:



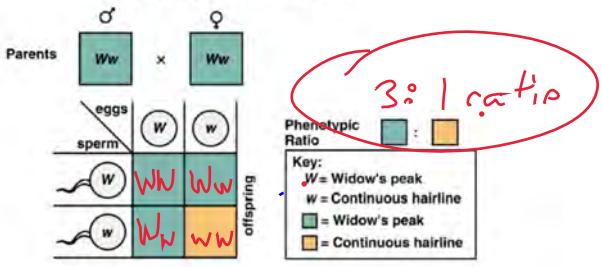


This square shows two round parents and their four possible offspring. Notice, there is a 75% chance their "kids" will be round and only a 25% chance they will be wrinkled.



This square shows a round and a wrinkled parent. Notice how the odds of having a wrinkled kid is now 50/50 to having a round kid.

Monohybrid Cross



3:1 ratio

ex) Work out the phenotypic ratio of the fertilization.

visible traits

Widow's Peak → WW, Ww and Ww → 3 possibilities

Cont. Hairline → ww → 1 possibility

ex) In a certain flower, the allele for yellow colour, Y, is dominant to the allele for orange colour, y. Determine the genotype and phenotype for each cross below:

	Y	y
Y	YY	Yy
Y	YY	Yy

phenotypes:

YY = yellow

Yy = also yellow

phenotypes

genotypes

	y	y
Y	Yy	Yy
Y	Yy	Yy

phenotypes: All yellow.

Note that there were two ways to come out yellow: YY or Yy.

Having the genotype YY makes you homozygous.

Having the genotype Yy makes you heterozygous.

So far, we have only looked at autosomal inheritance: inheritance that is transferred over the first 22 sets of chromosomes.

Sometimes, traits are found in the genes on the 23rd chromosome: the sex chromosome. These traits are said to have sex-linked inheritance.

For example, hemophilia is a disease that causes reduced ability for blood in affected individuals to clot.

The disease is transmitted only over the X-chromosome and is a recessive gene.

Let's say two parents, one of which has the disease, and one which only carries the recessive allele, have a child. Will the child have hemophilia?

Sex-linked
H = normal & h = hemophilia
Cross: XX^h x X^hY

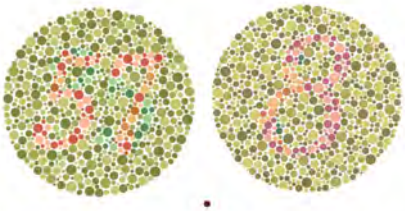
	X	X^h
X^h	X^hX	X^hX^h
Y	XY	X^hY

Genotypic ratio: 1:1:1:1
(X^hX=25% X^hX^h=25% XY=25% X^hY=25%)

Phenotypic ratio: 1:1:1:1
Female carrier =25% Female hemophilia =25%
Male normal =25% Male hemophilia =25%

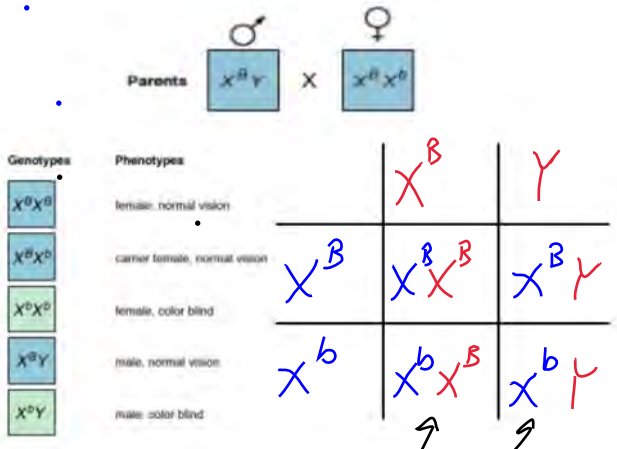
A Punnett square for this sex-linked gene looks like this. Note that the alleles are in superscript and the X and Y chromosomes are also written in.

Having two recessive genes in a female means the disease is present. Having one in the male means the disease is present.



Fun Fact!
Colourblindness is a sex-linked trait.

Let's work out an example of two individuals, a normal male and a female carrying the recessive colour blind gene, producing offspring and the chances of the offspring being colourblind.



These two will be colour blind.

Practice: page 96-98 #14 -22