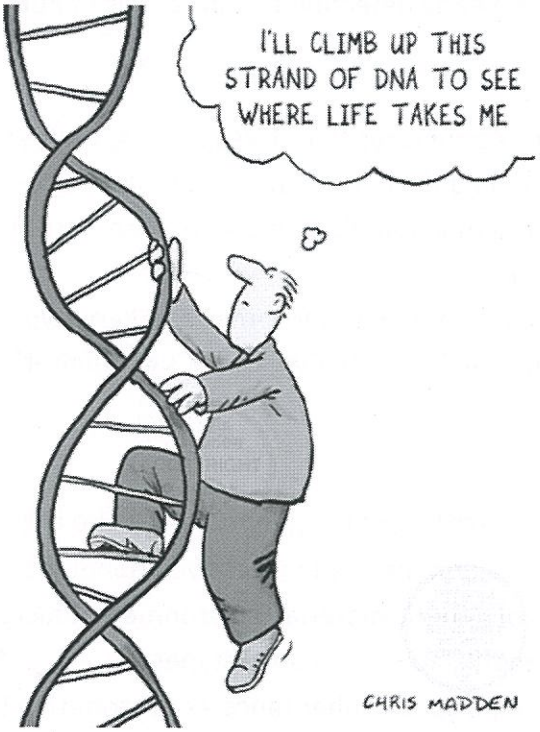
UNIT 2 BIOLOGY

AOS 2 Workbook

How is inheritance explained?



Name: Solutions

Teacher: _____

Date: _____

Unit 2 AOS 2: Study Design

Outcome 2

On completion of this unit the student should be able to apply an understanding of genetics to describe patterns of inheritance, analyse pedigree charts, predict outcomes of genetic crosses and identify the implications of the uses of genetic screening and decision making related to inheritance.

Key knowledge:

Genomes, genes and alleles

- The distinction between a genome, gene and allele
- The genome as the sum total of an organism's DNA measured in the number of base pairs contained in a haploid set of chromosomes
- The role of genomic research since the Human Genome Project, with reference to the sequencing of the genes of many organisms, comparing relatedness between species, determining gene function and genomic applications for the early detection and diagnosis of human diseases.

Chromosomes

- The role of chromosomes as structures that package DNA, their variability in terms of size and the number of genes they carry in different organisms, the distinction between an autosome and a sex chromosome and the nature of a homologous pair of chromosomes (one maternal and one paternal) as carrying the same gene loci
- Presentation of an organism's set of chromosomes as a karyotype that can be used to identify chromosome number abnormalities including Down's Klinefelter's and Turner's syndromes in humans.

Genotypes and phenotypes

- The use of symbols in the writing of the genotypes for the alleles present at a particular gene locus
- The distinction between a dominant and recessive phenotype
- The relative influences of genetic material, environmental factors and interactions of DNA with other molecules (epigenetic factors) on phenotypes
- Qualitative treatment of polygenic inheritance as contributing to continuous variation in a population, illustrated by the determination of human skin colour through the genes involved in melanin production or by variation in height.

Pedigree charts, genetic cross outcomes and genetic decision-making

- Pedigree charts and patterns of inheritance including autosomal dominant, autosomal recessive, X-linked and Y-linked traits
- The determination of genotypes and prediction of the outcomes of genetic crosses including monohybrid crosses, and monohybrid test crosses
- The inheritance of two characteristics as either independent or linked, and the biological consequence of crossing over for linked genes
- the nature and uses of genetic testing for screening of embryos and adults, and its social and ethical implications.

Date: _____

Chapter 10-Key terms

Adenine	Alleles	Antiparallel	Autosomes	Base
Centromere	Chromatid	Chromosomes	Complementary base pair	Complete dominance
Cytosine	Diploid	DNA	DNA sequencing	Dominance
Dominant phenotype	Double helix	Epigenetics	Gene	Genome
Genotype	Guanine	Haploid	Hemizygous	Hereditary
Heterogametic	Heterozygous	Histones	Homogametic	Homologous chromosomes
Homozygote	Homozygous	Human Genome Project	In vitro fertilisation (IVF)	Karyotype
Locus	Nucleosome	Phenotype	Ploidy	Polygene
Polygenic inheritance	Polypeptide	Pre-implantation genetic diagnosis (PGD)	Protein	Purines
Pyrimidines	Recessive phenotype	Reprogramming	Sex chromosomes	Somatic cell
Thymine	Trait			

Date: _____

Chapter 11-Key terms

Autosome	Carrier	Chiasma	Chromatid	Co-dominance
Cross	Crossing over	Dihybrid cross	DNA amplification	DNA polymerase
DNA profiling	DNA sequencing	Dominant	F1 generation	F2 generation
Gel electrophoresis	Gene mapping	Genetic screening	Genetic testing	Genome
Heterozygous	Homozygous hybrid	Law of Independent Assortment	Law of Segregation	Linkage
Locus	Monohybrid cross	Mutant	Nucleotide	Pedigree analysis
Recessive	Recombinant	Sex-linked inheritance	Spontaneous mutation	Testcross
Wild type	X-linked	Y-linked		

Textbook summaries (optional)

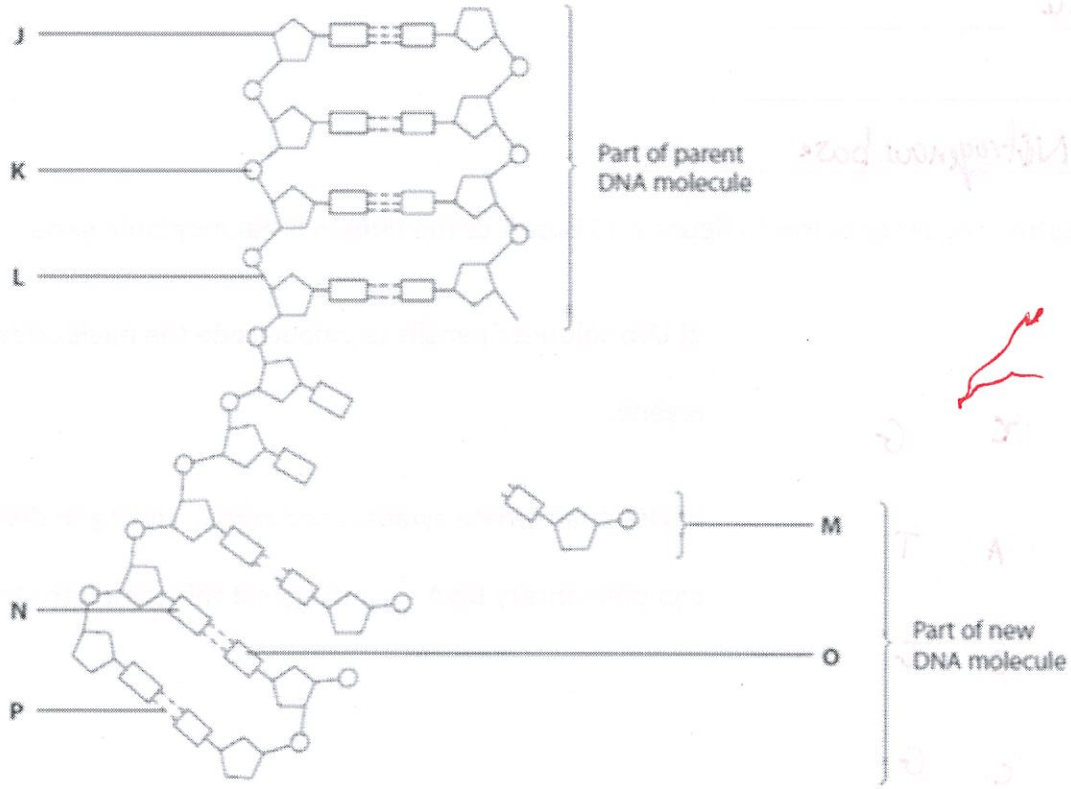
10.1, 10.2, 10.3, 10.4, 11.1, 11.2, 11.3, 11.4

Biozones

187	188	189	190	191	192	197	198	200	203	204
205	206	208	209	211	212	213	214	215	216	217
218	219	220	221	222	223	224	225			

Date: _____

Activity #1: DNA



1. **Name the structures/components of the DNA molecule above.**

Label	Structure/component	Additional information
J	Deoxyribose Sugar Pentose Sugar	Part of the phosphate - sugar backbone
K	Phosphate molecule	Part of phosphate sugar backbone
L	Sugar - phosphate bond	Holds phosphate + sugar together
M	Nucleotide	Phosphate, sugar + Nitrogenous base together
N	Nitrogenous base	Purine Adenine / Guanine Pyrimidines Thymine Cytosine
O	Complimentary Nitrogenous base	Purine pair with Pyrimidine
P	Hydrogen bonds	3 bonds between G + C 2 bonds between A + T

Date: _____

2. Nucleotides are composed of the same three components. Name the molecule represented by:

P: hosphate

S: ugar

A, T, C, G: Nitrogenous base

3. The nucleotide sequence below in figure 2.25 is part of the human β-haemoglobin gene.

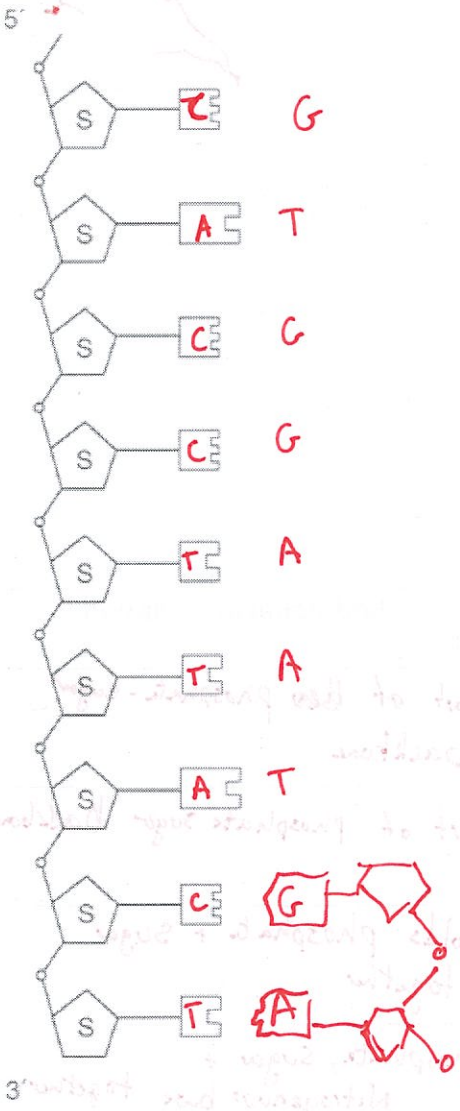


Figure 2.25 Sequence of nucleotide bases in the human haemoglobin gene

a) Use coloured pencils to colour-code the nucleotide bases in the legend.

b) Use appropriate symbols and colour-coding to draw the complementary DNA strand against this template strand.

4. Look carefully at the details of your double-stranded DNA. Describe 2 features of DNA that ensure complementary base-pairing occurs.

Feature 1:

That each side fits together

Feature 2:

The DNA is going the opposite way

Date: _____

4. Distinguish between DNA, genome, gene and allele.

DNA is made up of 4 Nucleotides A, G, C, T, that has a double helix structure

Genome is the entire DNA sequencing of an organism

Gene is a length of DNA that codes for a trait

Allele is different forms of the same gene.

Activity #2: The Human Genome Project

1. What was the original goal of the Human Genome Project?

Precise order of nucleotides within a DNA molecule and number of genes in one human individual

2. Reorder the following statements that describe the process of DNA sequencing in order from first to last.

A chromatogram is produced	3
DNA is replicated and the test tube mixture ends up with a range of fragments of DNA of different sizes (lengths)	2 1.
DNA is added to a mixture containing DNA polymerase, nucleotides, and terminating nucleotides that are tagged with fluorescent markers	1 2
Gel from gel electrophoresis is read by computers	5
Terminating nucleotides fluoresce as they pass through a laser beam	4

Date: _____

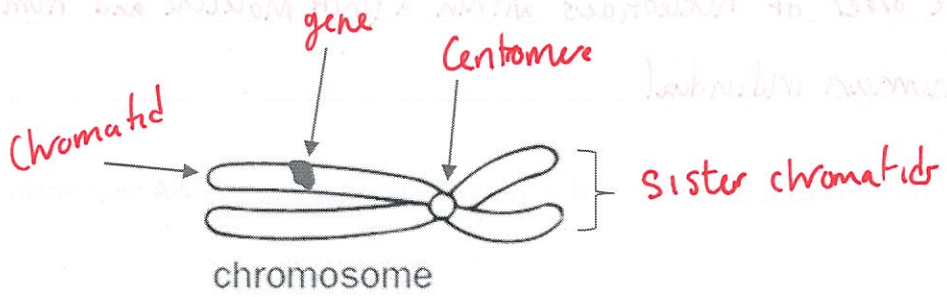
Activity #3: Chromosomes

1. **Using the terms chromosome, histone, DNA and nucleosome, describe how DNA is packaged into a cell nucleus.**

Double stranded DNA is wrapped around histones to create nucleosomes
These the supercoil and condense to form into chromosome.

2. **Label the parts on the chromosome using the following terms:**

Centromere **gene** **chromatid** **sister chromatids**



3. **Distinguish between the following terms:**

a) autosome and sex chromosome

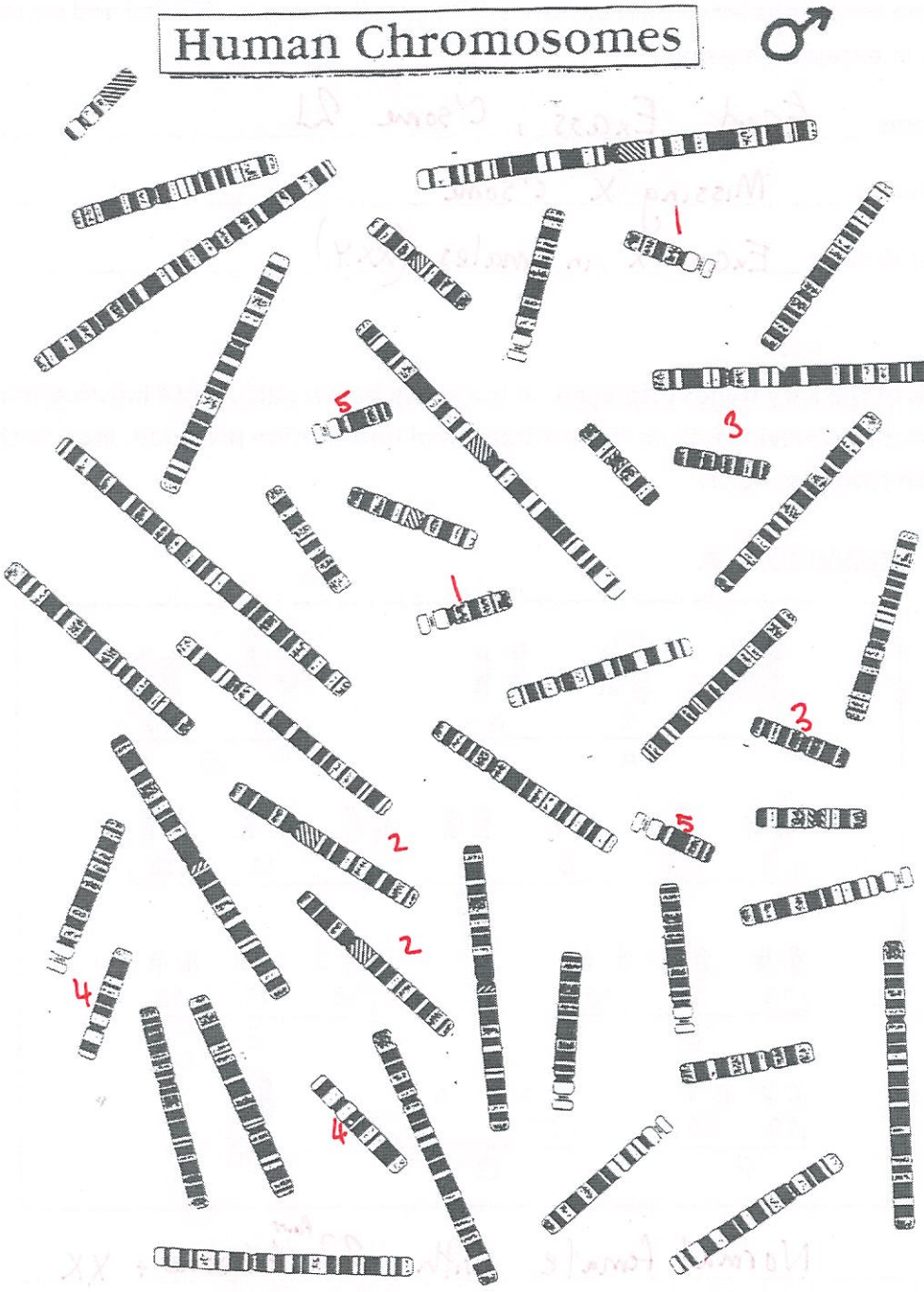
Autosomes carries all traits and a N° 1-22
Sex chromosomes determine the sex of the individual, 23

b) sex chromosome and homologues

Sex chromosomes can be homologous (the same) as seen in females
XX or non homologous in males XY.

Date: _____

4. Circle 5 pairs of homologous pairs in the picture below using a different coloured pencil for each pair.



5. Explain which features you used to match the chromosomes.

Size / ~~Gram~~ length of c'some

banding pattern of c'some

Date: _____

Activity #4: Karyotyping

1. For each of the conditions listed below, state which chromosome is affected and whether the chromosome is in excess or missing

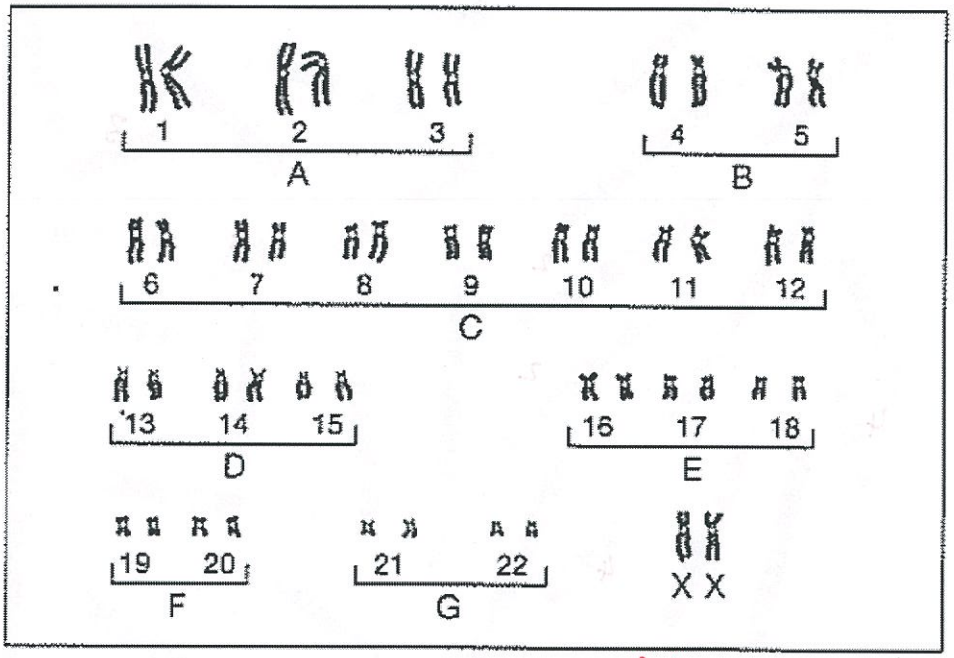
a) Down syndrome: Exact Excess, C'some 21

b) Turner syndrome: Missing X c'some

c) Klinefelter syndrome: Excess X in males (XXY)

2. Examine each of the karyotypes displayed. In the space below each, write information that can be determined about the individual from the chromosomal information provided. Include the general genotype in each case, e.g. 46XY.

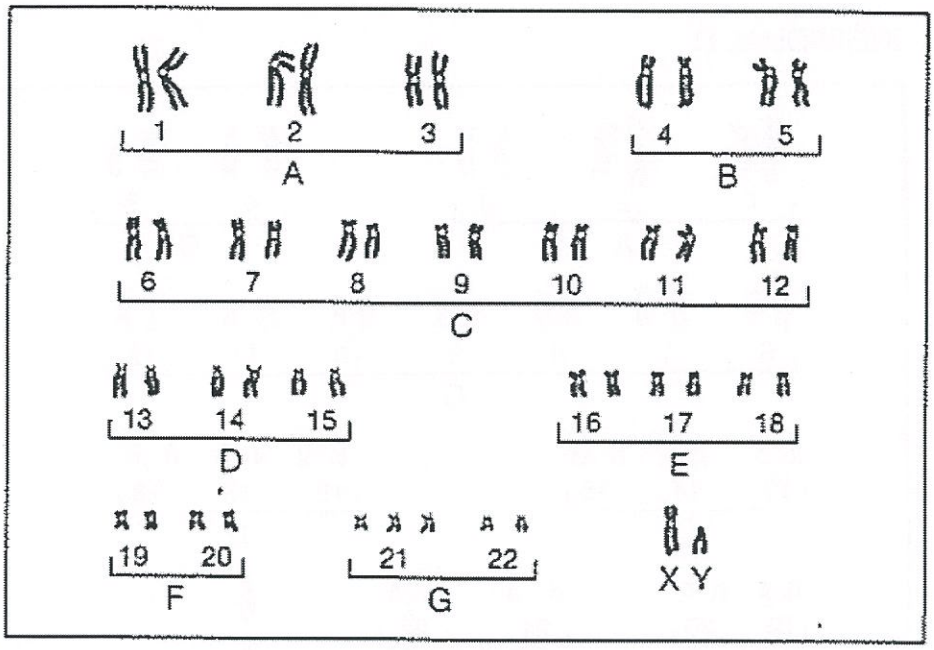
INDIVIDUAL A



Normal female with 22 Pairs Autosomes + XX

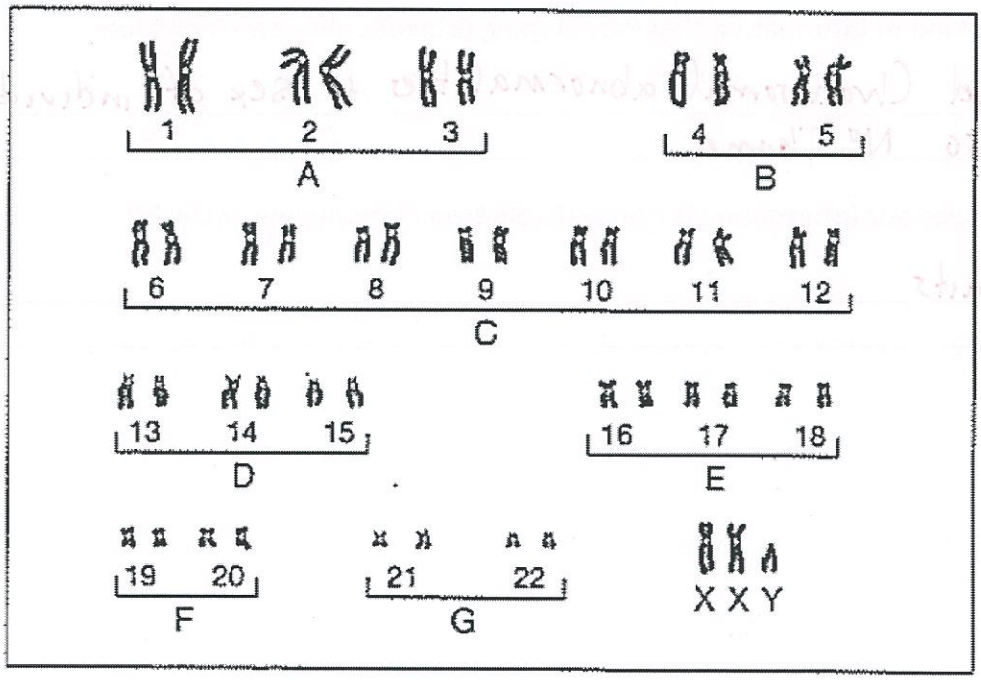
Date: _____

INDIVIDUAL B



Down syndrome male

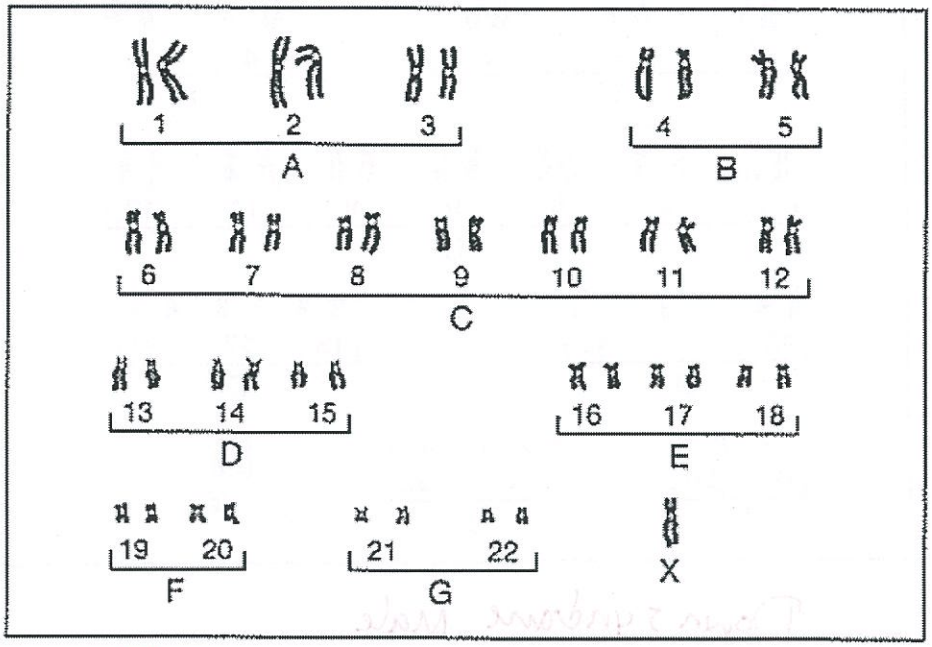
INDIVIDUAL C



Male with Klienfelters syndrome XXY

Date: _____

INDIVIDUAL D



Female with turner syndrome

3. Describe the kind of information that karyotyping provides about an individual.

Gender Chromosomal abnormalities + sex of individual also N° C'somes

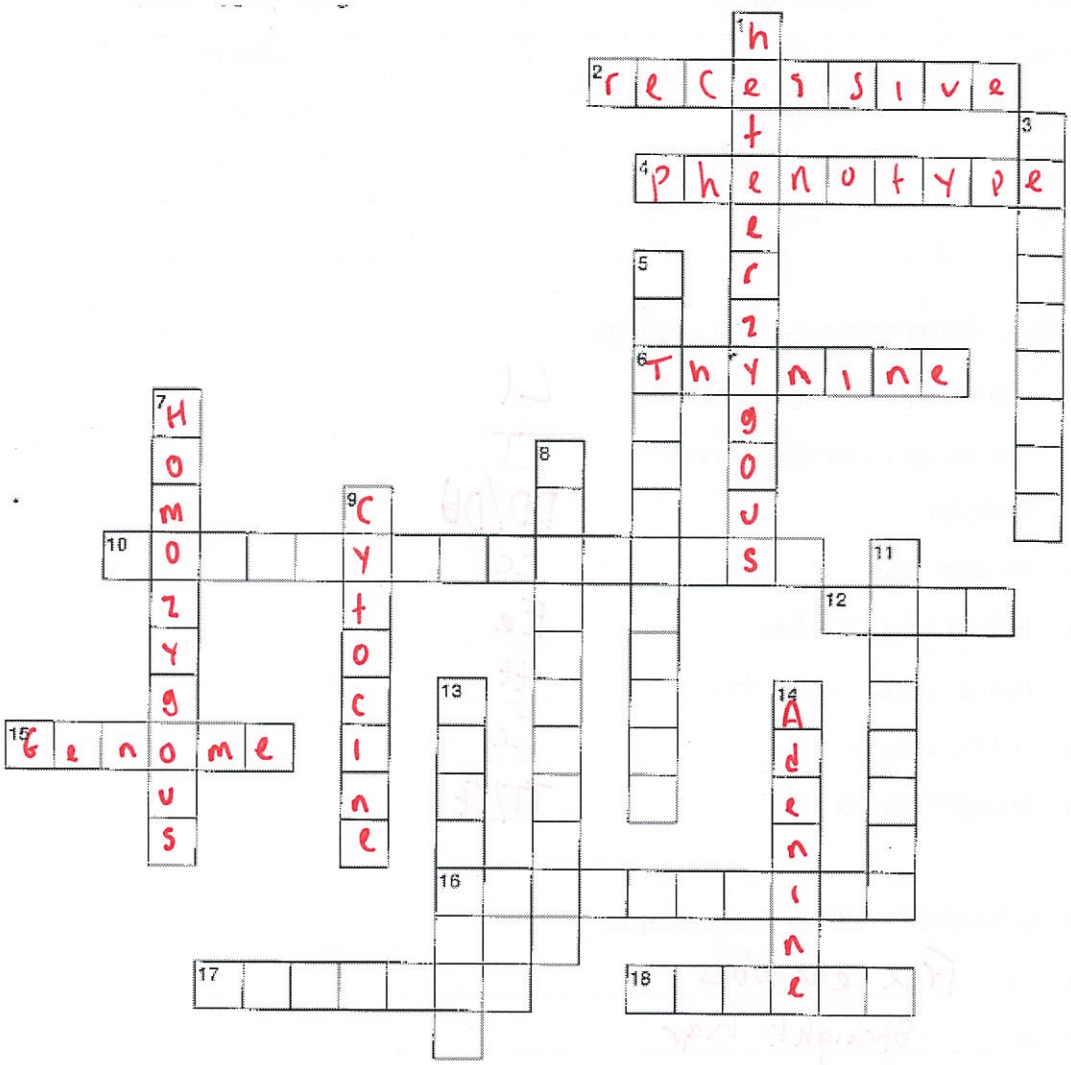
4. What kind of genetic information is not available from karyotyping analysis?

Traits

Date: _____

Activity #5: Crossword- genotypes and phenotypes

Complete the crossword puzzle to help you check your knowledge and understanding of key terms and processes related to genotypes, phenotypes and genetic crosses.



Across

2 Describes the characteristic that is observed in the phenotype of an individual homozygous for a particular allele, but not observed in the heterozygote. [9]

4 Physical expression of genotype. [9]

6 Nitrogenous base complementary to adenine in DNA. [7]

10 Cross between individuals that takes into account one particular characteristic. [15]

12 A unit of hereditary information that determines the characteristics of an organism. [4]

15 The full complement of genes in an individual organism. [6]

16 The structural unit of nucleic acids. [10]

17 Nitrogenous base complementary to cytosine in DNA. [7]

18 Alternative form of a gene. [6]

Down

1 Describes the status of an individual that carries two different forms of a gene in relation to a particular characteristic. [12]

3 Cross between an individual displaying a dominant phenotype and an individual displaying a recessive phenotype (homozygous) for the purposes of determining the genotype of the individual with the dominant phenotype. [9]

5 Describes the arrangement of the two complementary strands in a DNA molecule as they run in opposite directions. [12]

7 Describes the status of an individual's genotype when identical alleles are present. [10]

8 Describes the alternative forms of a characteristic that are either fully or partially expressed in the phenotype of an individual. [11]

9 Nitrogenous base complementary to guanine in DNA. [8]

11 Genetic make-up of an individual in relation to one or more genes. [8]

13 Describes a characteristic that is observed in the phenotype of a heterozygote. [8]

14 Nitrogenous base complementary to thymine in DNA. [7]

Date: _____

Activity #6: Genotypes and phenotypes

Use the following traits to determine the genotypes and phenotypes.

Trait	Dominant	Allele	Recessive	Allele
Ear lobes	Free ear lobes	E	Attached ear lobes	e
Hair type	Curly	C	Straight	c
Dimples	Dimples	D	No dimples	d
Thumb	Straight thumb	T	Curved thumb	t
Eyelashes	Long	L	Short	l

1. Write out the GENOTYPE(S) for these people:

a. Heterozygous long eyelashes Ll
b. Homozygous straight thumb TT
c. Dimples DD/Dd
d. Straight hair cc
e. Hybrid free ear lobes Ee
f. Homozygous curved thumb tt
g. Hybrid curly hair Cc
h. Straight thumb TT/Tt

2. Write out the PHENOTYPES for these people:

a. Ee Free ear lobes
b. cc Straight hair
c. DD Dimples
d. Dd Dimples
e. Tt Straight thumb
f. ll Short eyelashes
g. Ll Long eyelashes
h. CC Curly hair
i. LL Long eyelashes
j. Cc Curly hair

Date: _____

Activity #7: Review questions 1

1. What is the difference between the alleles of a gene?

A. Their locus on the chromosome

B. Their amino acid sequence

C. The type of sugar on the nucleotides

D. The sequence of bases

2. What was the aim of the Human Genome Project?

A. to identify human infectious diseases

B. to make improvements to the human genome

C. to allow transfer of genes from other species to humans

D. to sequence genetic information in humans

3. What does a nucleosome consist of?

A. DNA and histones

B. DNA and chromatid

C. Chromatid and nucleotides

D. RNA and histones

4. Which of the following correctly identifies the relationship between alleles, chromosomes and genes?

A. Genes contain chromosomes and alleles

B. Chromosomes contain genes but not alleles

C. Alleles are found in chromosomes but not in genes

D. Genes are parts of chromosomes and have different alleles

5. The term 'genome' applies best to all the

A. Genes present in a cell

B. Organelles present in a cell

C. Proteins produced by a cell

D. Metabolites produced by a cell

Date: _____

6. Chromosomes from eukaryotic cells are made of

A. carbohydrates

B. phospholipids and proteins

C. nucleic acids and fatty acids

D. nucleic acids and proteins

7. In leaf cutting ants, a male develops from an unfertilised egg and a female from a fertilised egg. It is reasonable to assume that

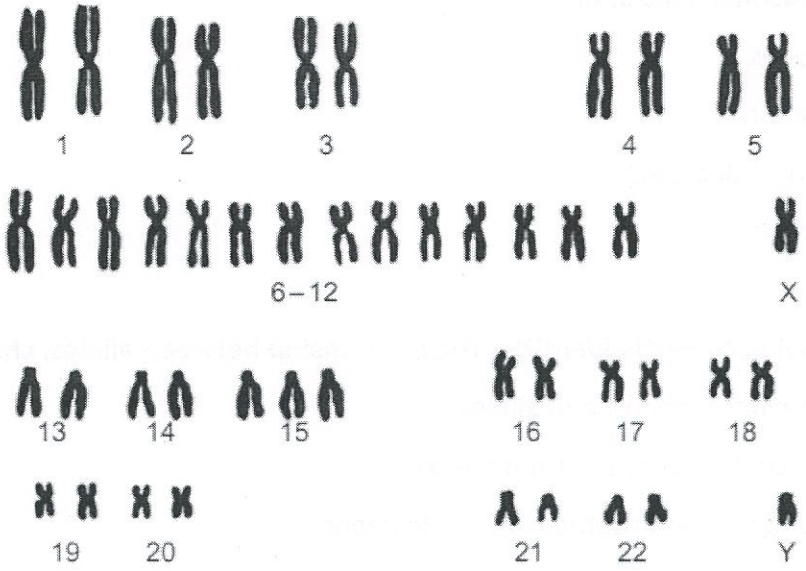
A. sperm produced by a particular male are genetically identical

B. males can be either homozygous or heterozygous at any gene locus

C. unfertilised eggs from a particular female develop into identical males

D. homologous pairs of chromosomes are found in both male and female ants

8. The following karyotype is from a human baby with a genetic defect.



The condition indicated by the karyotype is an example of

A. monosomy

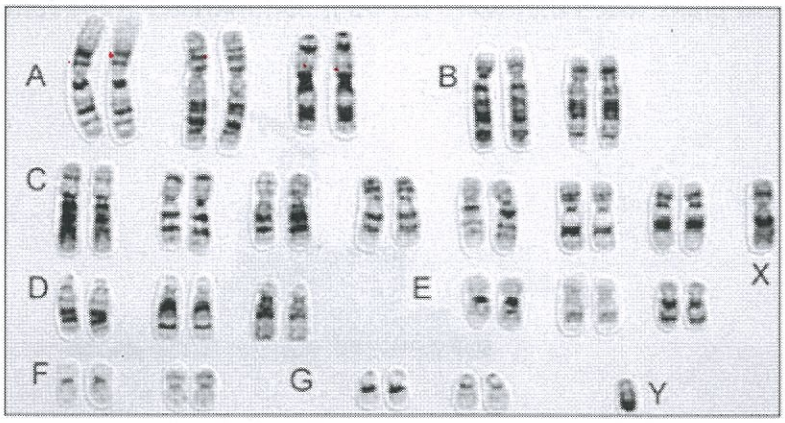
B. polyploidy

C. inversions

D. trisomy

Date: _____

9. The number of autosomes in the karyotype below is:



A. 22

B. 23

C. 44

D. 46

10. Examination of the karyotype reveals that the baby

A. Is a male

B. Has a defective allele

C. Has an extra X chromosome

D. Has three number 13 chromosomes

11. What is the genotype of pure breeding plants?

A. heterozygous

B. homologous

C. homozygous

D. monohybrid

12. Identical twins have the same genotype. Why are there small differences between the phenotypes of identical twins?

A. Some genes are not co-dominant

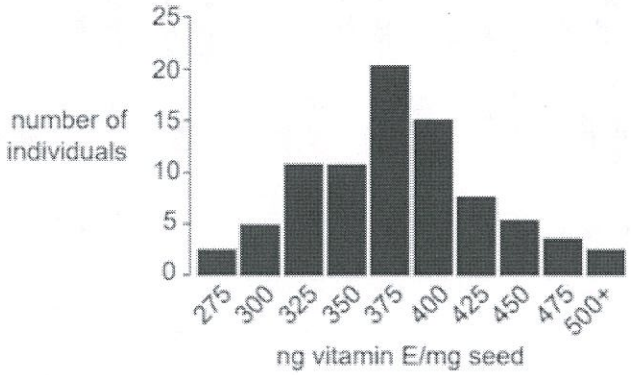
B. Environment affect the expression of genes

C. Both parents are homozygous for those phenotypes

D. Chromosomes segregate independently during meiosis

Date: _____

13. Scientists have been studying the amount of vitamin E in a corn plant. The amount of vitamin E in hundreds of different plant seeds that were tested is summarised in the following graph.



It is reasonable to conclude that the vitamin E phenotype of corn plants is a result of:

A. cloning

B. asexual reproduction

C. polygenic inheritance

D. discontinuous variation

14. State the number of autosomes and homologous chromosomes in a human

a) Female somatic cell 22 pairs of homologous c'some

b) Male somatic cell 22 pairs of homologous c'some

15. In mice, coat colour is controlled by a single gene. Black coat colour is dominant to white coat colour.

a) Assign allele symbols for the gene responsible B black b white

b) How many genotypes are possible with respect to these alleles? State the genotypes and phenotypes.

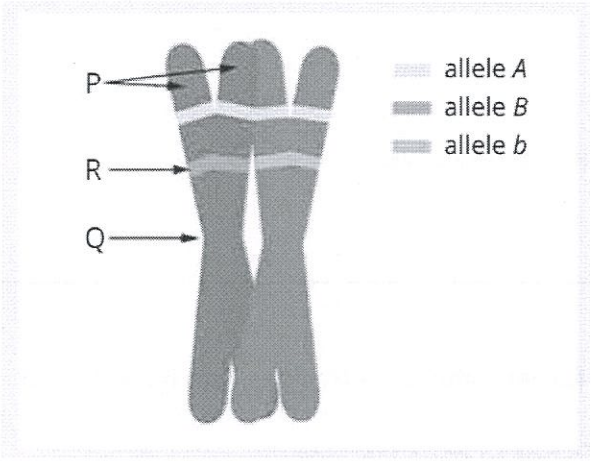
BB - Homo black

Bb - Hetero black

bb - Homo white

Date: _____

16. The diagram below shows a pair of chromosomes during meiosis to form a human sperm. The position of the alleles of some of the genes is shown.



a) Identify the chromosome structures labelled P and Q.

P: Chromatids

Q: Centromere

b) Suggest with reasons, whether the chromosomes are:

i- sex chromosomes or autosomes

Could be female XX chromosomes or autosomes as they are homologous

ii- homologous or non-homologous

homologous as they are same size and have same banding pattern i.e. genes on each have same loci

iii- homozygous, hemizygous or heterozygous with respect to the B gene locus

Heterozygous as has both B & b or 1 c'some is homo dom. and other is homo. res.

Date: _____

Activity #8: Monohybrid crosses

1. Freckles are an inherited trait which results in the formation of spots on fair skin. It is found on chromosome 4 and shows a dominant inheritance pattern.

a) State the type of inheritance (autosomal/sex-linked/dominant/recessive)

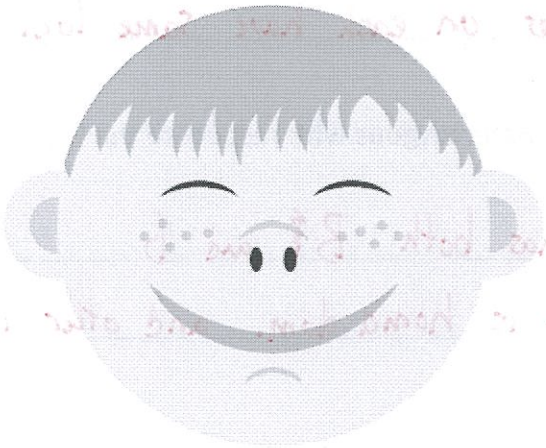
Autosomal dominant.

b) Complete the Punnett square to show how a mother and father, who have freckles, can have a child that does not have freckles. State the probability for the child not to have freckles.

Parents	F	f
F	FF	Ff
f	Ff	ff

F - Freckles
f - no freckles

Probability for the child not to have freckles = 25% chance has freckles



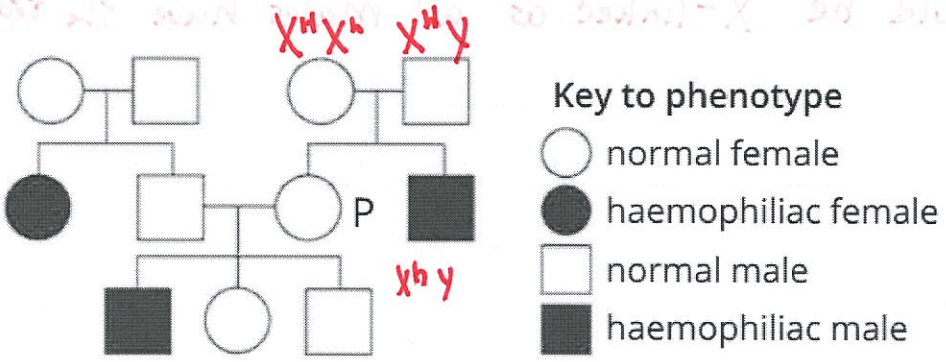
Date: _____

2. Robert has blood type A and Lee has blood type B. Is it possible for them to have a baby of blood type O? What is the probability of this occurring? Use the Punnett square below to help explain your answer.

Parents	I^A	i
I^B	$I^A I^B$	$I^B i$
i	$I^A i$	ii

Is possible but both have to be heterozygous

3. The figure below shows the inheritance of haemophilia in a family. Haemophilia is a recessive X-linked inheritance.



a) What is the genotype of individual P? Show your working using a Punnett Square and appropriate symbols.

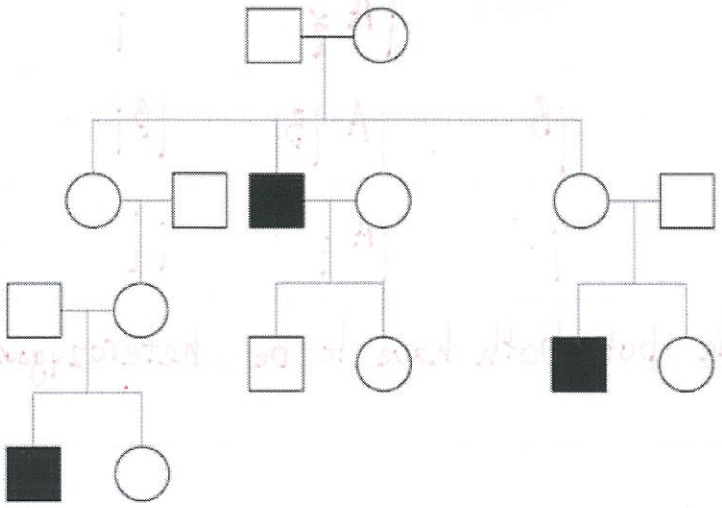
H - normal
h - haemophiliac

Parents	X^H	X^h
X^H	$X^H X^H$	$X^H X^h$ ← P
Y	$X^H Y$	$X^h Y$

Genotype of individual P = $X^H X^h$

Date: _____

4. What type of inheritance is shown in the pedigree below? Give three reasons for your choice of inheritance pattern?



Recessive - Parents don't show trait but children do.

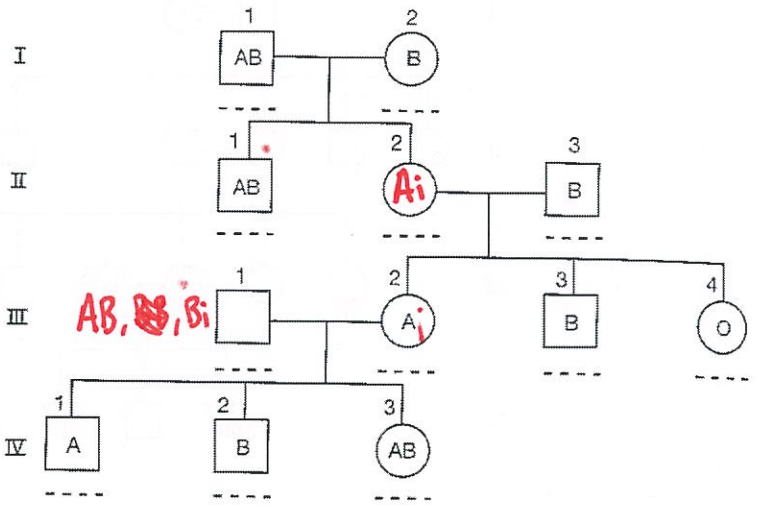
Could be X-linked as all males have the trait.

Date: _____

Activity #9: Puzzling pedigrees- analysing family histories

The ABO blood group of an individual can be determined by identifying the kinds of proteins (antigens) that are present on the surfaces of red blood cells. The single gene locus that codes for the production of these antigens has three alleles ($I^A, I^B and\ i$). The genotypes and phenotypes of respective individuals are shown in the table below.

Genotype	Phenotype
I^AI^A	A
I^Ai	A
I^BI^B	B
I^Bi	B
I^AI^B	AB
ii	O



1. The pedigree above indicates the blood type for some individuals. Use your understanding of inheritance and the alleles above to assign genotypes and blood types to individuals II-2 and III-1.

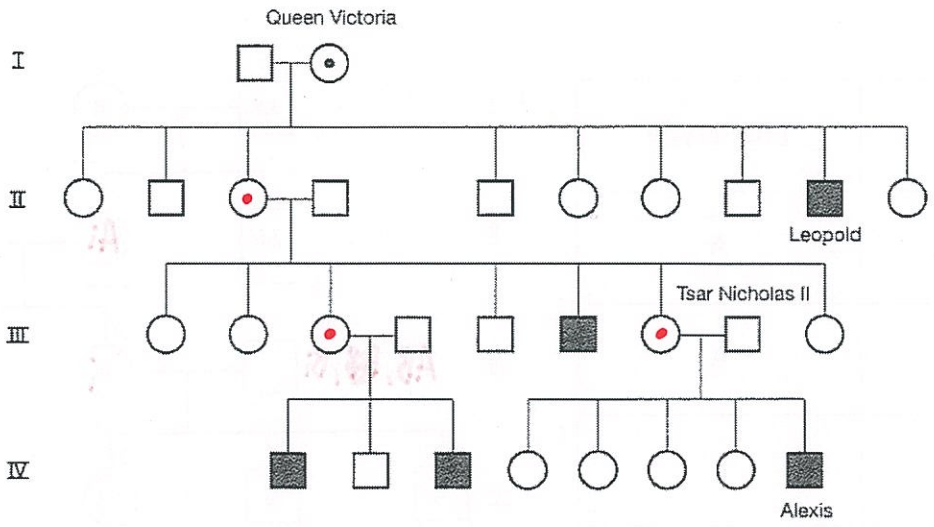
2. Outline the relationship between the phenotypic expression of the I^A, I^B and i alleles.

I^A is blood type A (A antigens + B antibodies) I^B blood type B (B antigens, A antibo
i is recessive O type that has no antigens and both antibodies.

Date: _____

Activity #10: Royal blood

The pedigree below represents part of the family tree for a European royal family. It also tracks the inheritance of haemophilia, a blood disorder that leaves sufferers without an important clotting factor, leading to uncontrolled bleeding after even minor injury. Today, haemophiliacs are successfully treated with blood transfusions, but in the past individuals born with this disorder usually did not survive childhood.



1. Suggest why only males in this family tree are affected by haemophilia.

It is an X-linked disorder.

2. Queen Victoria's son, Leopold, was the first person in the family's history to have been diagnosed with the condition. The cause of the disease in this family is attributed to a mutation that occurred early in the embryological development of Queen Victoria or in a germ-line cell from one of her parents. Describe the evidence from this family tree that points to Queen Victoria as the origin of haemophilia in the family, and not her son Leopold.

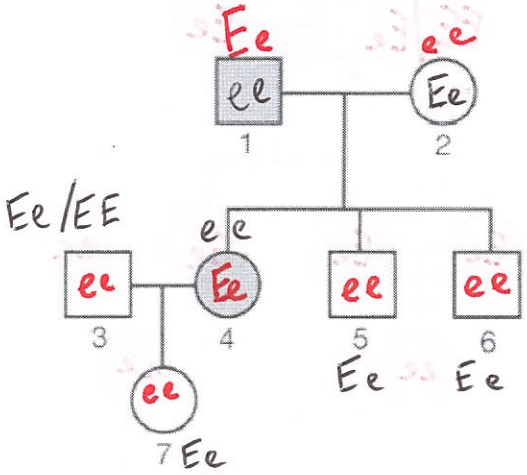
Leopold did not have children therefore did not pass it on.
Also daughters, granddaughters passed the trait on. Plus ⊙ means carrier.

3. In the pedigree, Queen Victoria's status as a carrier is denoted by the dot symbol. Use the same notation to identify all of the other carriers of haemophilia in this family.

Date: _____

Activity #11: Pedigree analysis- Scenario 1

The pedigrees in Figures 2.32 and 2.33 show the inheritance pattern of earlobe shape in two different families. 'Free lobes' are dominant to 'attached lobes', which are recessive. The gene responsible for earlobe shape has two alternative alleles represented by E (free lobes) and e (attached lobes).



Depends what trait is in question.

Figure 2.32 Pedigree of earlobe inheritance

1. Assign genotypes to as many individuals as possible in Figure 2.32

Date: _____

Activity #11 continued: Pedigree analysis- Scenario 1

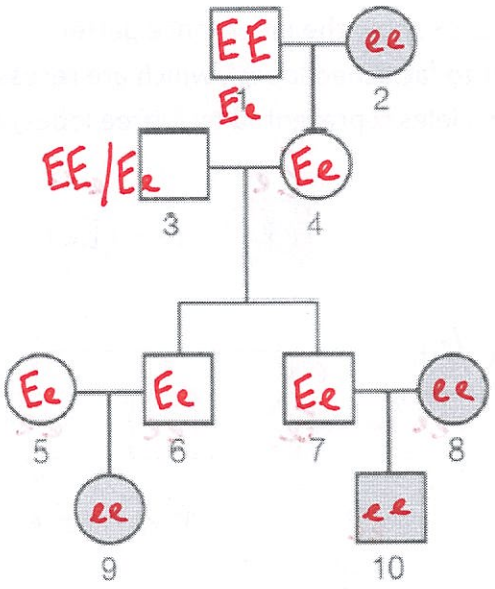


Figure 2.33 Pedigree of free and attached earlobe inheritance in a family

2. Examine the pedigree in Figure 2.33. Assign genotypes to as many individuals as possible.

3. Why is it difficult to do this with confidence for individuals 1 and 3?

As the could be homo or. hetero because kids don't have trait and 3 is from outside family.

4. How can you be sure of the genotypes of individuals 6 and 7?

They have kid with trait so must be a carrier

Date: _____

Activity #12: Pedigree analysis- Scenario 2

Known family histories are also useful to geneticists in establishing the mode of inheritance for particular genetic diseases. Pedigree analysis for families that show such diseases is also important so that genetic counselling can be provided to families about the likelihood of future children being affected or carrying the allele in question. Figure 2.34 illustrates the inheritance of Huntington's disease in 2 unrelated families. Huntington's disease is a neurological disorder that leads to gradual, permanent deterioration of nerve and muscle control with eventual complete dependence on care. Death results after some years. The onset of the symptoms does not occur until at least the mid to late thirties.

Figure 2.34 Two pedigrees of Huntington's disease

1. Assign genotypes to each person in both pedigrees.

2. Name the mode of inheritance for Huntington's disease. Explain your choice.

Dominant as appears in both generations in pedigree 1

Individuals 7 and 8 are engaged to be married. Both individuals are keen to raise a family.

3. What are the chances of any children from this union developing Huntington's disease? Show your working.

50% as it dominant

	H	h
h	Hh	hh
h	Hh	hh

4. Suggest options that a genetic counsellor might discuss with such a couple.

Designer babies? To ensure offspring does not get H gene.
Early genetic testing?

Date: _____

Activity #13: Pedigree analysis- Scenarios 3 and 4

People with galactosaemia are unable to digest milk sugar (galactose).

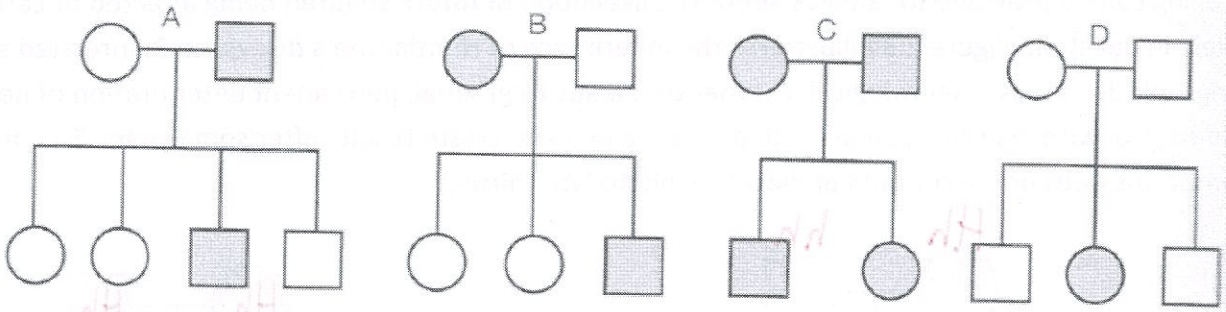


Figure 2.35 Four families with galactosaemia

1. From the evidence of the pedigrees should in Figure 2.35, suggest which pedigree shows beyond doubt that galactosaemia is inherited as an autosomal recessive condition. Explain your reasoning.

D, Parents do not have it, offspring does.

Red-green colour blindness is a relatively common condition, inherited as an X-linked recessive trait. Figure 2.36 shows the pedigrees of 3 families in which this condition occurs.

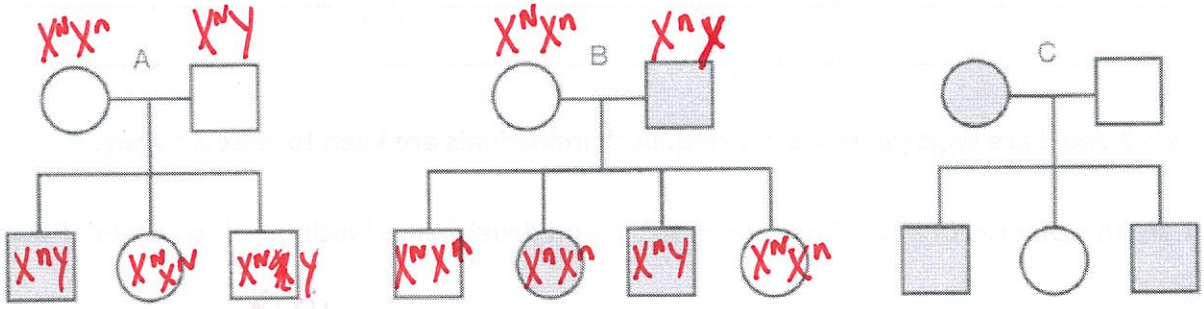


Figure 2.36 Pedigrees of red–green colour blindness.

2. Which of the three pedigrees best establishes the mode of inheritance for this trait? Explain your reasoning.

A or B A- see above

B- see above.

Date: _____

Activity #14: Linked genes and crossing over

1. For each of the following statements, circle whether it is true or false.

- Genes are linked when the percentage of recombinant gametes falls below 50%

TRUE (FALSE)

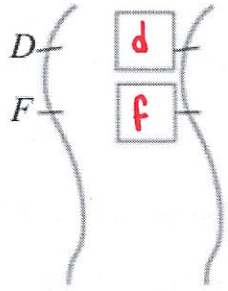
- Recombinant gametes are observed in the offspring

(TRUE) FALSE

- If A and B loci are very close together, the probability of a random cross over event is very low.

TRUE (FALSE)

2. Sheep blowfly chromosome 5 carries genes for resistance to the insecticide dieldrin (gene D). The same chromosome carries a gene called furrowed eyes (F).



a) Complete the allele symbols for a fly that is heterozygous at both loci.

b) If no crossing over occurs in meiosis, the gametes will carry either DF or df alleles. What combinations of alleles will be present in gametes if crossing over does occur?

~~DDFF~~ ~~DdFF~~ ~~DdFf~~ ~~ddFF~~ ~~ddFf~~

DF Df. dF. df.

c) Complete the Punnett square below for a cross between the fly shown above (genotype DdFf) (after recombination has occurred in meiosis) and a homozygous recessive fly (ddff).

Parents	DF	Df	dF / df
df	DF/df	Df/df	dF/df / df/df

2000 50 50 2000

Date: _____

Activity #15: Linkage and pedigrees- a summary

Make a selection from the list to fill in the missing words in each summary statement.

X-linked	Gene complex	Continuous	Pedigree	Sex linkage
Polygenic	Linkage	Crossing over	Stud books	Y-linked
Discontinuous	Recombinant	Dominant	Recessive	

- When 2 or more genes are located on the same chromosome they are referred to as a _____ group. The more closely such genes are situated on a given chromosome, the greater the likelihood that they will be inherited together.
- Recombinant gametes are formed as a result of Crossing over at a chiasma during prophase I in meiosis.
- Genes that are so closely linked on a chromosome that crossing over between them is a rare event are referred to as gene complex.
- Sex linked refers to the presence of genes on either of the sex chromosomes. In this case, the inheritance of characteristics is linked to the sex of the individual.
- Colour-blindness is an example of an X-linked characteristic. The mode of inheritance for this condition is X-linked recessive. Transmission is typically from a female parent to male offspring. X-linked characteristics appear less often in females because there are two X-chromosomes. When one X-chromosome is carrying the affected allele, it may be masked by a normal allele on the second X-chromosome. Male are more often affected because the allele is present on their only X-chromosome.
- Y linked inheritance shows a pattern of transmission from father to son. Characteristics that follow this mode of inheritance are never observed in females.
- Pedigree analysis is a strategy that allows geneticists to track the pattern of inheritance of particular characteristics. This provides important information about the mode of inheritance of characteristics and can be useful in calculating the likelihood of genetic diseases occurring in families.

Date: _____

Activity #15 continued: Linkage and pedigrees- a summary

Make a selection from the list to fill in the missing words in each summary statement.

X-linked	Gene complex	Continuous	Pedigree	Sex linkage
Polygenic	Linkage	Crossing over	Stud books	Y-linked
Discontinuous	Recombinant	Dominant	Recessive	

- Animal breeders looking to breed desirable characteristics avoid inbreeding and maintain genetic variation by keeping records called Stud books to track breeding stock over generations.
- When alternative forms of a particular characteristic can be clearly placed into non-overlapping groups, Discontinuous variation is said to exist. Such characteristics are typically governed by single genes.
- Continuous. variation describes the kinds of characteristics that show wide variation across a range. Such characteristics are typically governed by a number of genes and are referred to as Polygenic traits.
- Characteristics that appear in the phenotype of a heterozygote are described as Dominant.
- Characteristics that do not appear in the phenotype of the heterozygote are described as Recessive.

Date: _____

Activity #16: What am I?

1. I am a cross between two individuals with different alleles at a single locus.

What am I? _____

2. I am a type of inheritance that refers to a dominant trait that is passed on to offspring via an autosomal gene.

What am I? Autosomal dominant Complete dominance

3. I am a type of inheritance in which both alleles are expressed in varying degrees in the phenotype of the heterozygous individuals.

What am I? Incomplete dominance

4. I am a type of inheritance where phenotypes are inherited through genes on sex chromosomes.

What am I? Sex-linked

5. I am a type of inheritance where the traits are predominantly expressed in males because males carry only one X chromosome.

What am I? X-linked

6. I am a type of inheritance where a trait is passed from father to son and never observed in females.

What am I? Y linked

7. I am a type of inheritance that is likely if two parents do not have a particular phenotype but one or more of their offspring does.

What am I? recessive

8. I am a type of inheritance that is likely if both parents show the trait but one or more of their offspring do not show the trait.

What am I? Hetero dominant

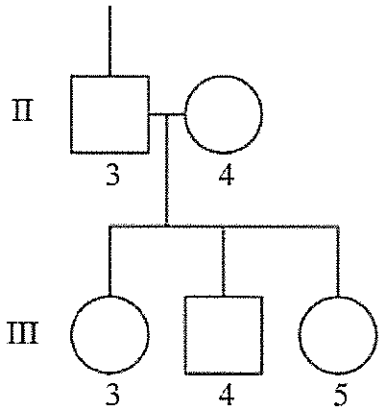
Date: _____

Activity #17: Review questions 2

1. Why might the results of a monohybrid cross differ from the expected ratio of 3:1? Select the correct answer.

A. mutations
B. alleles not segregating
C. chance
D. incomplete meiosis

2. The figure below shows part of a family pedigree. If individual III-3 was shaded, which of the following best describes the trait?



A. dominant
B. sex-linked
C. recessive
D. co-dominant

Date: _____

3. If individual III-5 was shaded, what would the genotypes of the parents be? Choose from options A-D and draw a Punnett Square to show your reasoning.

Parents		

A. BB, BB

B. Bb, Bb

C. X^BX^B, X^BY

D. X^BX^B, X^bY

4. What does 'carried on the X-chromosome' and 'occurs more in males than females' suggest?

A. A monohybrid cross

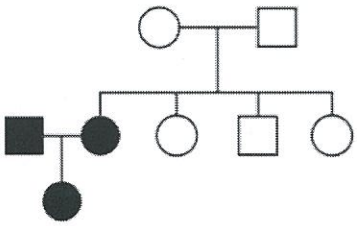
B. A dihybrid cross

C. Mendel's experiments

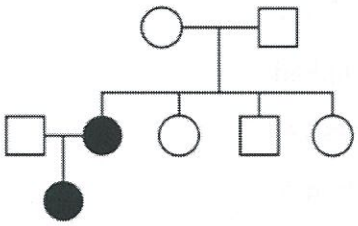
D. Sex-linked inheritance

5. Which pedigree represents an X-linked dominant trait?

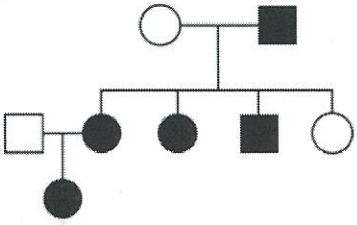
A.



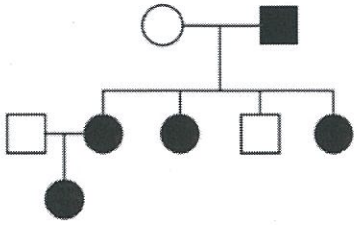
B.



C.

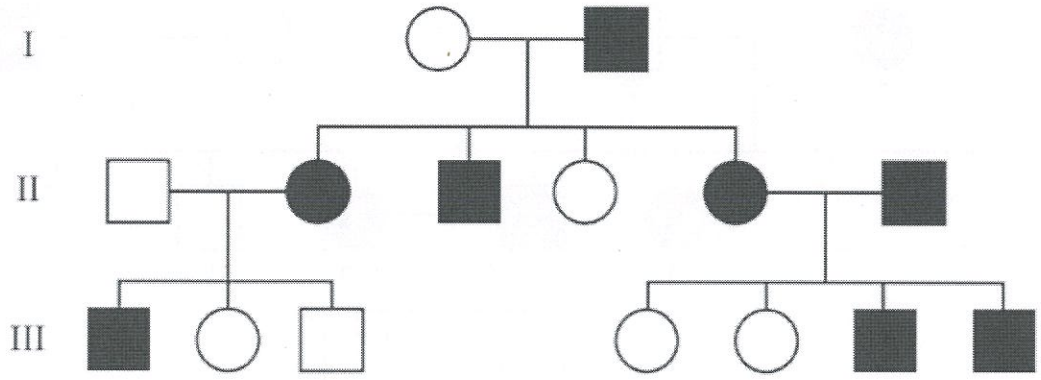


D.



Date: _____

6. In the following pedigree, shaded individuals have a particular genetic trait.



The mode of inheritance of the trait is:

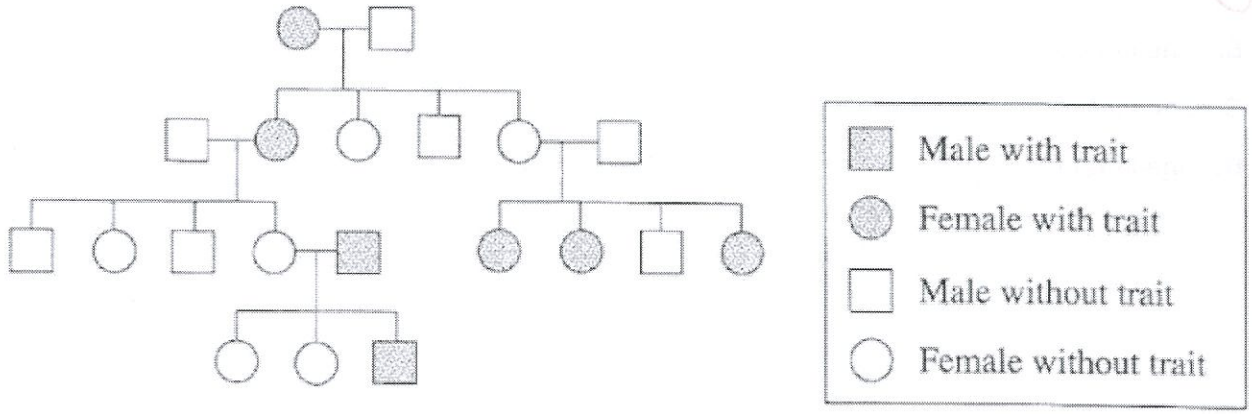
A. X-linked dominant

B. X-linked recessive

C. Autosomal recessive

D. Autosomal dominant

7. A family tree is shown.



What is represented by this family tree?

A. Sex-linked inheritance

B. Polygenic inheritance

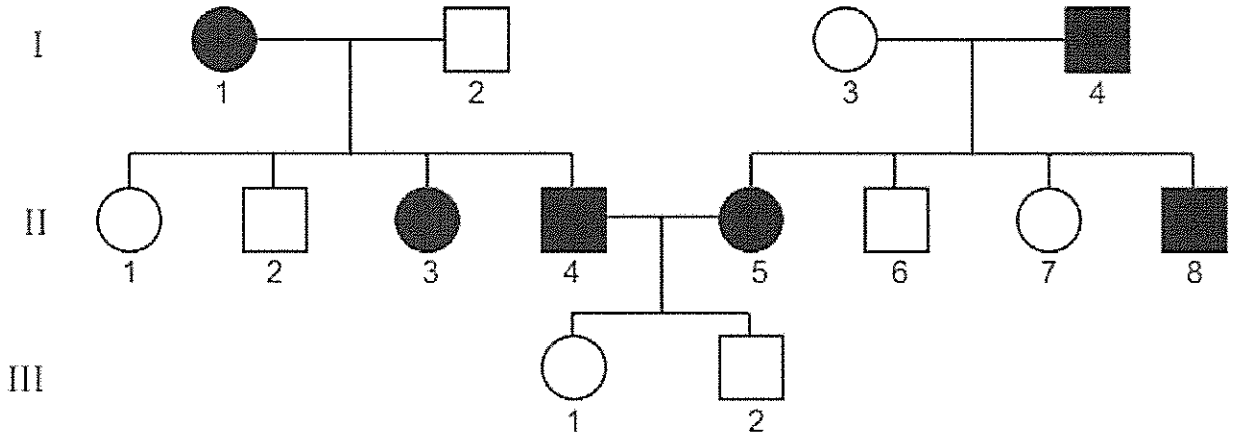
C. Inheritance of a recessive trait

D. Inheritance of a dominant trait

Date: _____

Use the following information to answer questions 8 and 9.

Examine the following pedigree.



8. The mode of inheritance of the trait shown in the pedigree is

A. X-linked recessive

B. X-linked dominant

C. Autosomal recessive

D. Autosomal dominant

9. If individuals II-2 and II-7 married, the chance that their first child would have the trait is

A. zero

B. one in two

C. one in three

D. one in four

Date: _____

Use the following information to answer questions 10 and 11.

In humans, the ABO blood group has a single autosomal gene locus with three possible alleles. There are four different blood group types. The different blood group types and their genetic makeup are shown in the following table.

Blood group type	Possible alleles
Group O	ii
Group A	I^AI^A or I^Ai
Group B	I^BI^B or I^Bi
Group AB	$I^A I^B$

10. A woman of blood group A, whose genotype is unknown, and a man of blood group O have a child. Genetically, this is an example of a

A. self cross

B. test cross

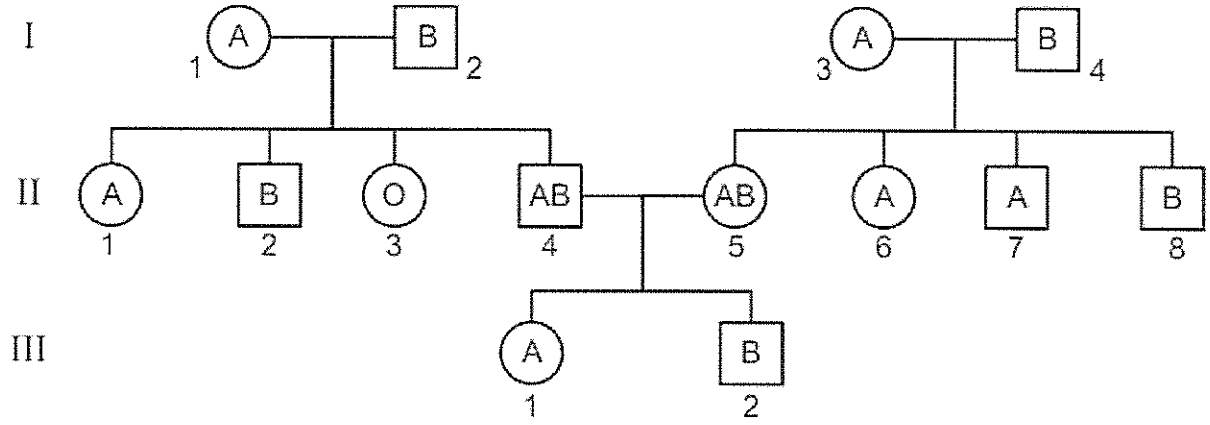
C. dihybrid cross

D. sex-linked cross

Date: _____

Blood group type	Possible alleles
Group O	ii
Group A	I^AI^A or I^Ai
Group B	I^BI^B or I^Bi
Group AB	$I^A I^B$

11. Examine the following pedigree, which shows the phenotype with respect to the ABO gene locus of each individual.



Individuals that would be homozygous at the ABO gene locus include

A. I-3

B. II-2

C. II-6

D. III-2

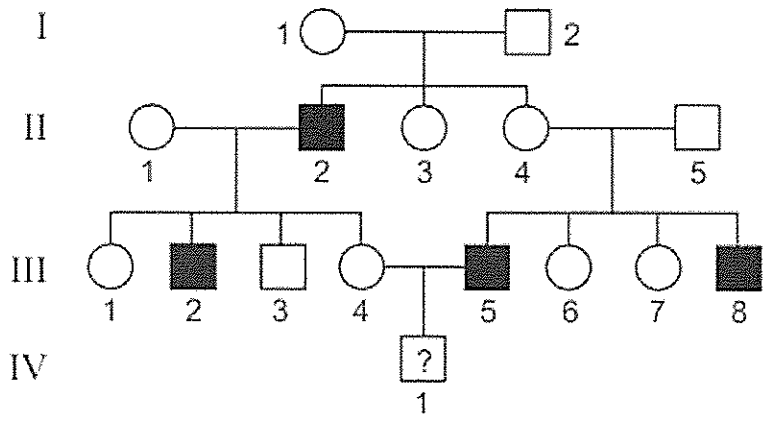
Date: _____

12. Red-green colour blindness is an X-linked recessive trait with the alleles:

$$X^R = \text{normal colour vision}$$

$$X^r = \text{red} - \text{green colour vision}$$

Examine the following pedigree



With respect to this gene, it is reasonable to predict that individual

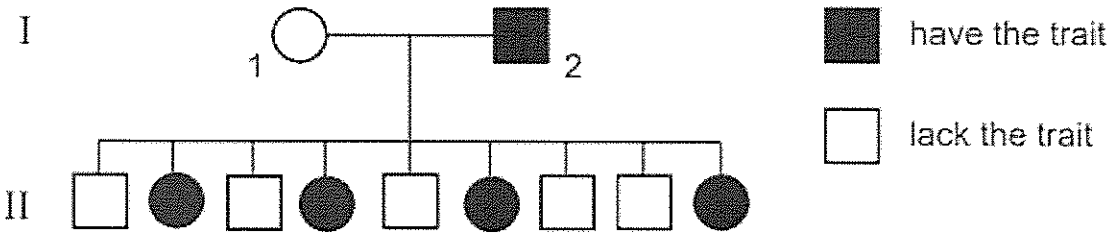
A. II-3 must be $X^R X^R$

B. III-4 must be $X^R X^r$

C. II-4 has a two in three chance of being $X^R X^R$

D. IV-1 has a one in four chance of being colour blind

The following pedigree shows the inheritance of an X-linked dominant trait in a family.



13. It is reasonable to assume that the

A. Mother of I-1 had the trait

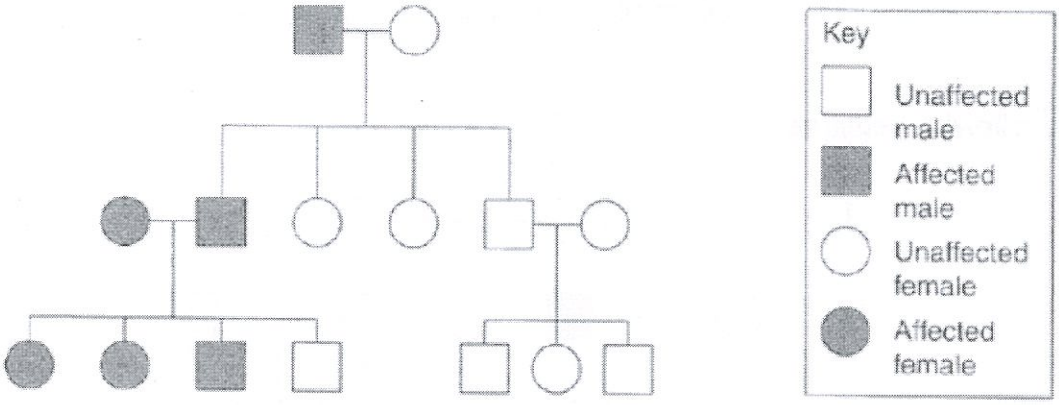
B. Father of I-1 had the trait

C. Mother of I-2 had the trait

D. Father of I-2 had the trait

Date: _____

14. A pedigree is shown.



What type of inheritance is shown in the pedigree?

A. Sex-linked inheritance

B. Sex-linked dominant

C. Non sex-linked recessive

D. Non sex-linked dominant

15. Cystic fibrosis is an autosomal recessive trait that affects many parts of the body, particularly the lungs and other organs. Parents who show none of the characteristics of cystic fibrosis have an affected child. The chance that their next child will be phenotypically normal is

A. Three in four

B. One in four

C. One in two

D. Zero

16. The presence of freckles is a dominant characteristic. A child's mother has no freckles and its father is heterozygous for freckles. What is the probability that this child will have freckles?

A. 25%

B. 50%

C. 75%

D. 100%

Ff
f
f

Date: _____

17. In humans, brown eye colour is dominant and blue eye colour is recessive. A brown-eyed boy and a blue-eyed girl have a blue-eyed mother. What eye colour does the father have and why?

A. Brown because the gene for brown eye colour is sex-linked

B. Brown because at least one of the parents must have brown eyes

C. Blue because at least two other members of the family have blue eyes

D. Blue because at least one of the parents must be heterozygous for eye colour

18. Two genes for coat colour in dogs have the following alleles.

Gene 1	Gene 2
B: black	S: solid colour
b: brown	s: white spotting

It is reasonable to conclude that a dog with the genotype

A. **BB Ss** would be black with white spotting

B. **Bb Ss** would be brown with white spotting

C. **bb SS** would be a solid brown colour

D. **bb ss** would be a solid black colour

19. In cats, coat colour and fur length are inherited characteristics. The two genes involved are on different chromosomes and have the following alleles.

Coat colour	Fur length
B: black	S: short
b: brown	s: long

A breeder, Joyce, obtained a cat, Felix, which has short black fur. Joyce wanted to determine if Felix was heterozygous or homozygous at the two gene loci.

To do this, it is best that Joyce carries out a test cross between Felix and a female cat with the genotype:

A. Bb Ss

B. Bb ss

C. bb ss

D. bb Ss

Date: _____

20. The shape of a human earlobe is determined by a single autosomal gene. Free lobe is dominant to attached lobe.

a) Write appropriate allele symbols for this gene

Ee

b) How many genotypes are possible with respect to these alleles? How many phenotypes are possible?

3 geno

2 pheno

c) A homozygous man with free lobes married a heterozygous woman. Show the genotypes and phenotypes possible in their children.

	E	e
E	EE	Ee
E	EE	Ee

d) Can two people with free lobes have a child with attached lobes? Explain your answer.

Yes need to be heterozygous

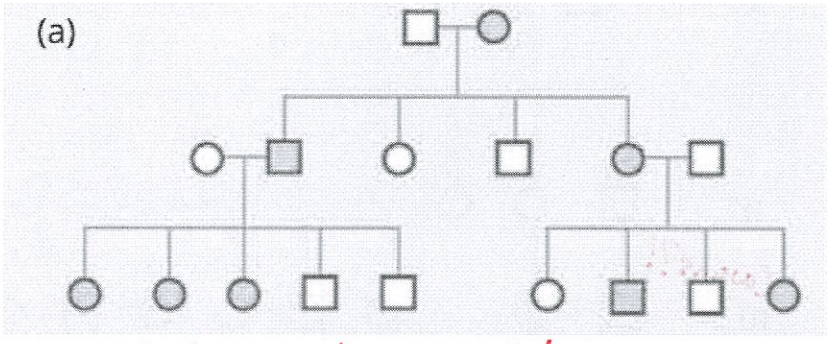
e) Two parents heterozygous for earlobe shape have a child. What is the probability that the child has attached lobes? Write your answer as a percentage and as a ratio.

25% 3:1

Date: _____

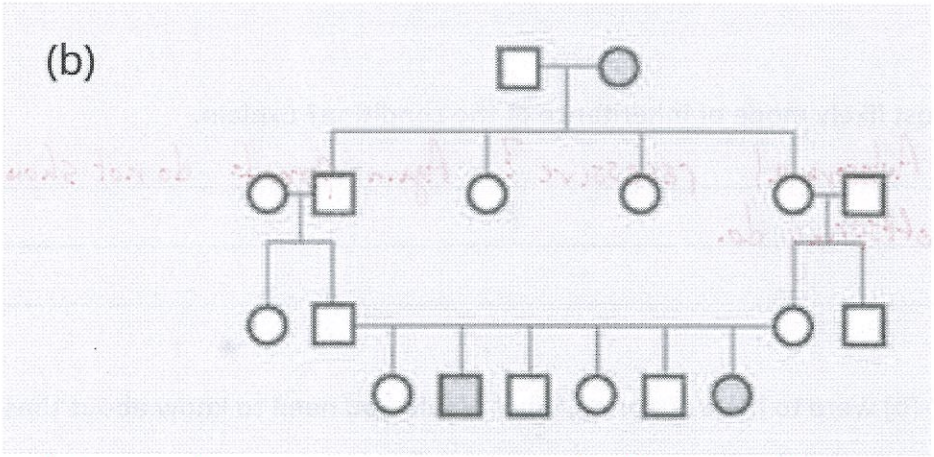
21. What is the most likely mode of inheritance for each of the diseases shown in the following pedigrees? Explain your choices.

(a)



Autosomal dominant. Can't be X as not all boys have nor does father.

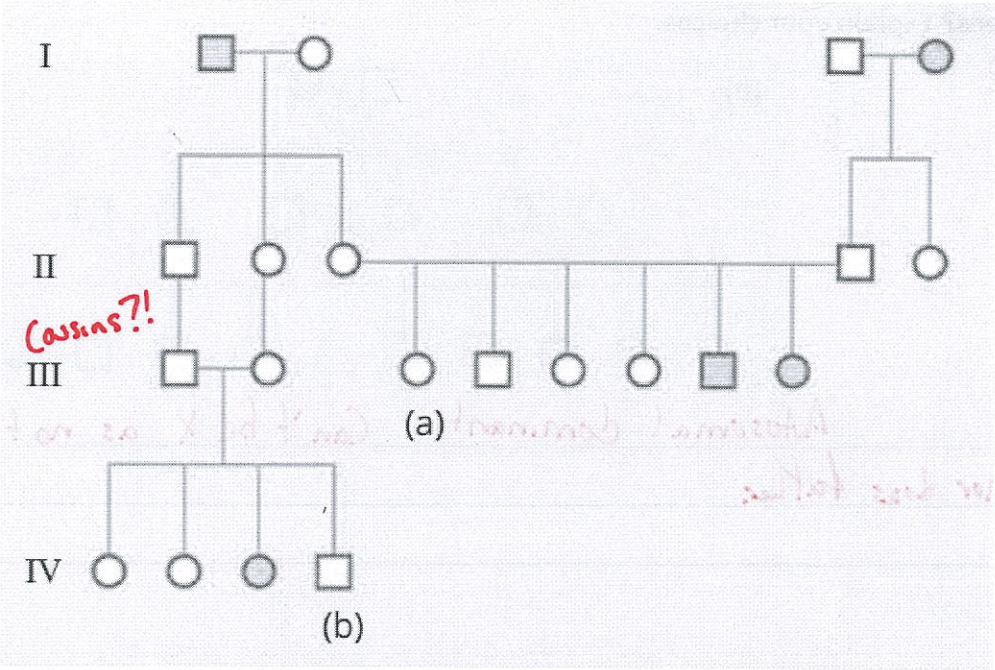
(b)



Autosomal recessive as parents do not show trait but offspring do

Date: _____

22. The following pedigree shows the inheritance of albinism.



a) What is the most likely mode of inheritance of the condition? Explain.

Autosomal recessive? Again parents do not show trait but offspring do.

b) If III-(a) and IV-(b) were to have offspring, what would you need to know about these individuals to calculate the chances of their offspring having albinism?

Whether they were homo or hetro for the ~~gene~~ allele.