PONTEFRACT
ACADEMIES TRUST

OUT OF LESSON WORK TERM 1 SCIENCE Y11

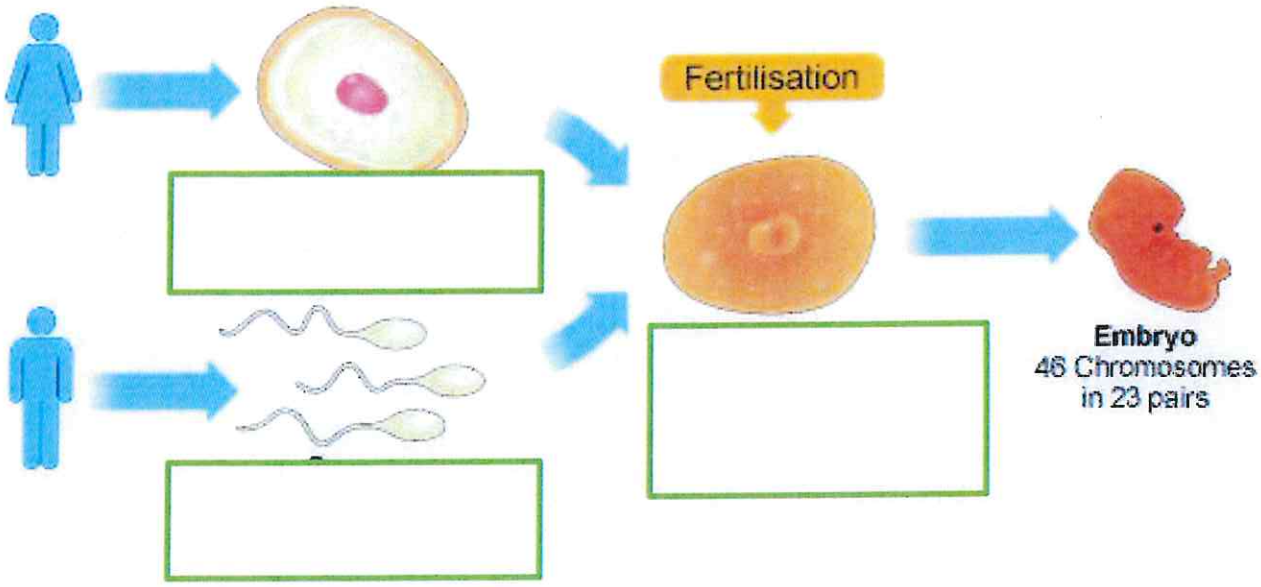
PONTEFRACT
ACADEMIES TRUST

Contents page

The answers are at the back of this booklet so that you can mark and improve your written work.

Lesson 1: SEXUAL AND ASEXUAL REPRODUCTION

1. Label the diagram.



2. Explain in your own words what the above diagrams shows

_____

_____

_____

_____

3. Why is there variation in sexual reproduction?

_____

_____

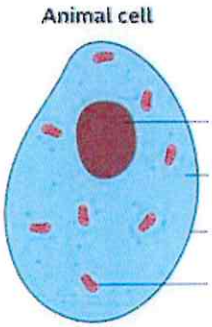
_____

4. Complete the table.

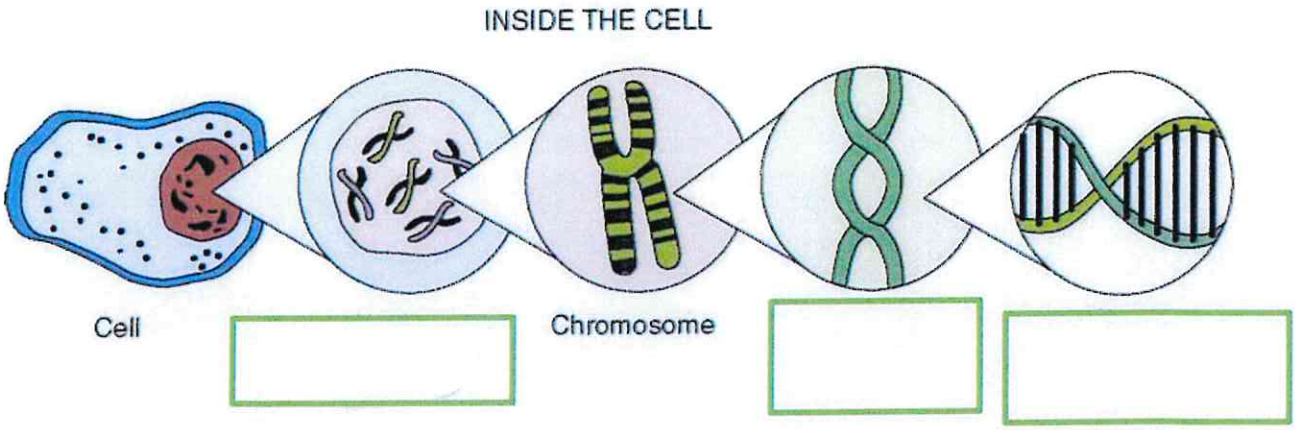
	Sexual	Asexual
How many parents?		
Does it create **variation**?		
Does it involve **gametes**?		
Examples include?		

Lesson 1: SEXUAL AND ASEXUAL REPRODUCTION

1. Label the animal cell.

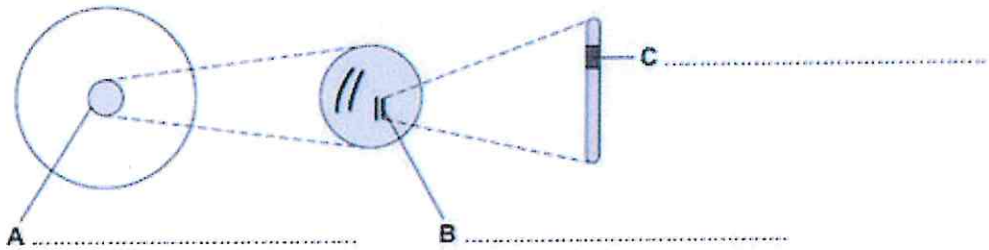


2. Label this diagram.



3. Diagram 1 shows an animal cell and some of the structures inside the cell.

Diagram 1



(a) Use words from the box to label structures A, B and C, on Diagram 1.

Characteristic	Chromosome	Gamete	Gene	Nucleus

(3)

4. Name the male gamete _____

5. Name the female gamete _____

6. Where are the male gametes produced? _____

7. Where are the female gametes produced? _____

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Lesson 2: MEIOSIS

1. What are the 2 types of cell division?

_____

_____

2. Which type of cell division produces genetically identical cells?

_____

3. What is **meiosis**?

_____

4 Where does **meiosis** occur in the body?

_____

5. How many times does the cell divide in **meiosis**?

_____

6. How many **chromosomes** do **gametes** have?

_____

7. Why?

_____

_____

8. Describe what happens in **meiosis.**

_____

_____

_____

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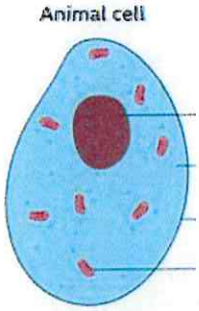
Lesson 3: DNA STRUCTURE

1. Label the diagram.



2. What structures are found within the **nucleus**?

_____

3. What are these structures made of? _____

4. What is a **gene**?

_____

5. What does a **gene** code for? (What is the function of a **gene**?)

_____

_____

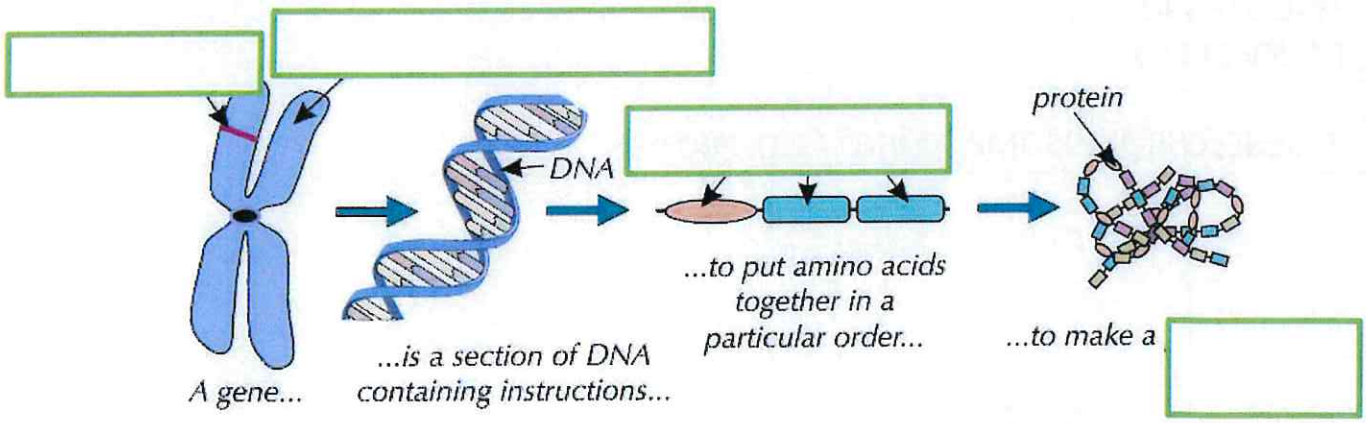
6. Describe the structure of **DNA**.

_____

_____

_____

7. Label the diagram.



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Lesson 4: GENETIC CROSSES

Genetic crosses of single **gene** combinations (monohybrid inheritance) can be shown and examined using Punnett squares.

1.

- At fertilisation, the **alleles** for eye colour from the father and the **alleles** for eye colour from the mother will fuse
- If the father is has brown eyes and his **genotype** is BB and the mother has blue eyes and her **genotype** is bb, what are the possible combinations of their offspring?

	B	B
b		
b		

- What is the genotype of the offspring? _____
- Are the offspring heterozygous or homozygous? _____
- What % of the offspring have brown eyes? _____

2.

- The height of pea plants is controlled by a single **gene** which has two **alleles**: tall and short.
- The tall **allele** is **dominant** and is shown as T.
- The small **allele** is **recessive** and is shown as t.
- Show a cross between a tall plant TT and a short plant tt

	T	T
t		
t		

- What is the genotype of the offspring? _____
- Are the offspring heterozygous or homozygous? _____
- What % of the offspring are short plants? _____

Lesson 4: GENETIC CROSSES

Genetic crosses of single **gene** combinations (monohybrid inheritance) can be shown and examined using Punnett squares.

1.

- At fertilisation, the **alleles** for eye colour from the father and the **alleles** for eye colour from the mother will fuse
- If the father is has brown eyes and his **genotype** is BB and the mother has blue eyes and her **genotype** is bb, what are the possible combinations of their offspring?

	B	**B**
b	Bb	Bb
b	Bb	Bb

- What is the genotype of the offspring? Bb
- Are the offspring heterozygous or homozygous? hetero
- What % of the offspring have brown eyes? 100

2.

- The height of pea plants is controlled by a single **gene** which has two **alleles**: tall and short.
- The tall **allele** is **dominant** and is shown as T.
- The small **allele** is **recessive** and is shown as t.
- Show a cross between a tall plant TT and a short plant tt

	T	**T**
t	Tt	Tt
t	Tt	Tt

- What is the genotype of the offspring? Tt
- Are the offspring heterozygous or homozygous? Hetero
- What % of the offspring are short plants? 0

Lesson 5: Inheritance Rehearsal

Use your knowledge of 'Inheritance' key terms and the process of genetic crosses to decide whether the following are TRUE or FALSE (make sure you can explain <u>why</u> it is TRUE o r <u>why</u> it is FALSE):

1. 'bb' is an example of a homozygous genotype _____
2. The word 'allele' means the same thing as the word 'gene' _____
3. Chromosomes are made of DNA _____
4. A somatic cell contains 46 pairs of chromosomes _____
5. All living organisms contain gametes _____
6. Genes are found within chromosomes _____
7. 2 identical gametes are made in Mitosis _____
8. Females have more chromosomes than males _____
9. Each parent passes on 23 chromosomes to their child _____
10. 'HH' is an example of a phenotype _____

11. 'bb' x 'bb' will always produce 'bb' offspring _____
12. Brown-eyed parents always have brown-eyed children _____
13. There is a 50% chance of parents having a boy _____
14. 'Hh' x 'HH' = 25% chance of 'HH' _____
15. 'Ff' x 'Ff' = 50% chance of having a carrier _____
16. Parents with polydactyly have children with polydactyly _____
17. Parents with Cystic Fibrosis (CF) have children with CF _____
18. 'BB' is described as Homozygous Dominant _____
19. Recessive alleles are less likely to be passed on _____
20. Phenotypes are determined by genotypes _____

Lesson 6: SEX DETERMINATION

1. What is the genotype for males? _____

2. What is the genotype for females? _____

3. Complete the genetic cross diagram to show the determination of sex.

	X	X
X		
Y		

4.

Complete each sentence by choosing the correct terms from the box.

23	**46**	**ADH**	**DNA**	**XX**	**XY**	**YY**
dominant	**female**	**male**	**recessive**	**strong**	**weak**	

A gene is made up of a substance called ..... . Genes are found on chromosomes and most human cells contain ..... pairs of chromosomes. In females the two sex chromosomes are ....., but in males the two sex chromosomes are .....

Alleles are alternative forms of a gene. Two healthy parents can sometimes have a child with a genetic disorder such as cystic fibrosis. This is because cystic fibrosis is caused by a ..... allele. The two parents are healthy because they also have the ..... allele.

(Total 6 marks)

Lesson 7: VARIATION

1. What is **variation**?

2. Why do children generally look a little like their mother and their father, but are not identical to either?

3. Complete the table.

Inherited	Environmental

4. State a characteristic that are influenced by both **environmental** and **inherited variation** and explain why.

5. What is a **mutation**?

6. When can **mutations** occur?

7. What affect do **mutations** normally have on the **phenotype**?

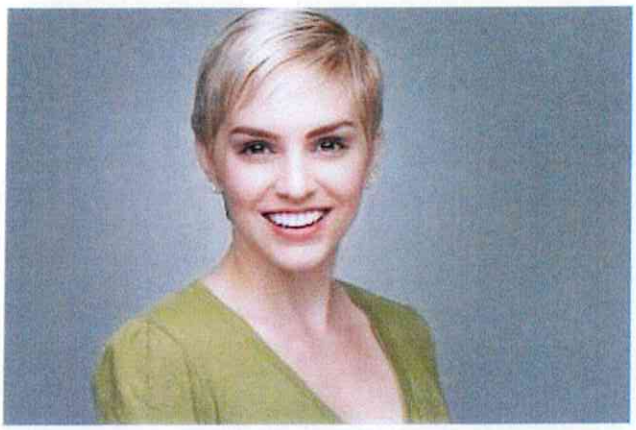
Lesson 7b: VARIATION EXAM PRACTICE

Variation in individual organisms can be caused by:

- genes
- the environment
- a combination of both genes and the environment

Figure 1 shows variations in a woman.

Figure 1



(a) What is the cause of each variation in the table below?

Tick only **one** box in each row.

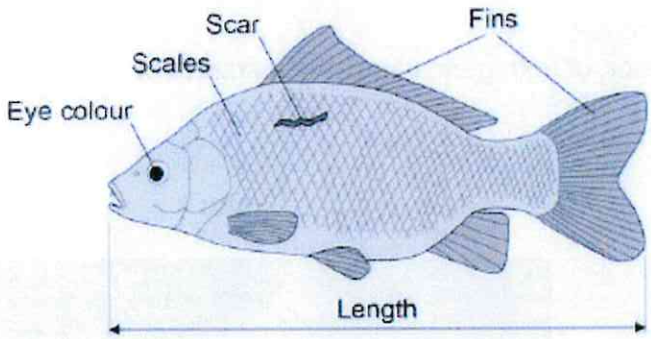
Variation	Cause of variation		
	Genes only	Environment only	Both genes and the environment
Brown eyes			
Light brown skin colour			
Short hair			

(3)

Lesson 7b: VARIATION EXAM PRACTICE

Figure 1 shows a fish called a carp.

Figure 1



The characteristics of an animal can be a result of:

- only genetic causes
- only environmental causes
- both genetic **and** environmental causes.

(a) Give **one** characteristic shown in **Figure 1** for each different cause.

Only genetic causes _____

Only environmental causes _____

Both genetic **and** environmental causes _____

_____

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Lesson 7b: VARIATION EXAM PRACTICE

A person's characteristics can be due to:

- environmental causes
- genetic causes
- both environmental and genetic causes.

(a) Complete **Table 1**.

Put a tick to show what each characteristic is due to.

Table 1

Characteristic	Characteristic due to		
	Environmental causes	Genetic causes	Both environmental and genetic causes
Eye colour			
A scar			
Weight			

(3)

Lesson 8: NATURAL SELECTION

Examine the table and construct a graph. Plot the years of the study on the X-axis, and the number of moths captured on the Y axis. You should have 2 lines on your graph - one for light moths, and one for dark moths.

Year	Number of Light Moths Captured	Number of Dark Moths Captured
2	537	112
3	484	198
4	392	210
5	246	281
6	225	337
7	193	412
8	147	503
9	84	550
10	56	599

1. Explain in your own words what your graph shows

2. What change in the environment could have occurred to cause the results shown in your graph?

3. What is a mutation?

Lesson 8b: NATURAL SELECTION

Use words from the box to complete the passage about natural selection.

evolution	**environment**	**generation**
mutate	**survive**	**variation**

Individual organisms of a species may show a wide range of

..... because of differences in their genes.

Individuals with characteristics most suited to the .....

are more likely to ..... and breed successfully.

The genes that have helped these individuals to survive are then passed on to the

next ..... .

(4 marks)

The theory of evolution by natural selection was suggested in the 1800s.

Which scientist suggested this theory?

.....

(1 mark)

Charles Darwin proposed the theory of natural selection.

(a) What is meant by natural selection?

.....

.....

.....

.....

(2 marks)

Lesson 8c: NATURAL SELECTION

1. What is evolution?

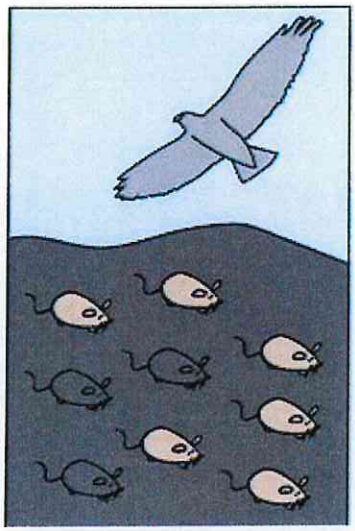
_____
_____
_____
_____

Which scientist came up with the theory of evolution? _____

2. What is a mutation?

_____

3. Look at the diagram below.



Which mice will survive and why?

_____
_____

Why will the other mice not survive?

_____
_____

What do the surviving mice then do?

_____
_____

4. What is natural selection sometimes referred to as?

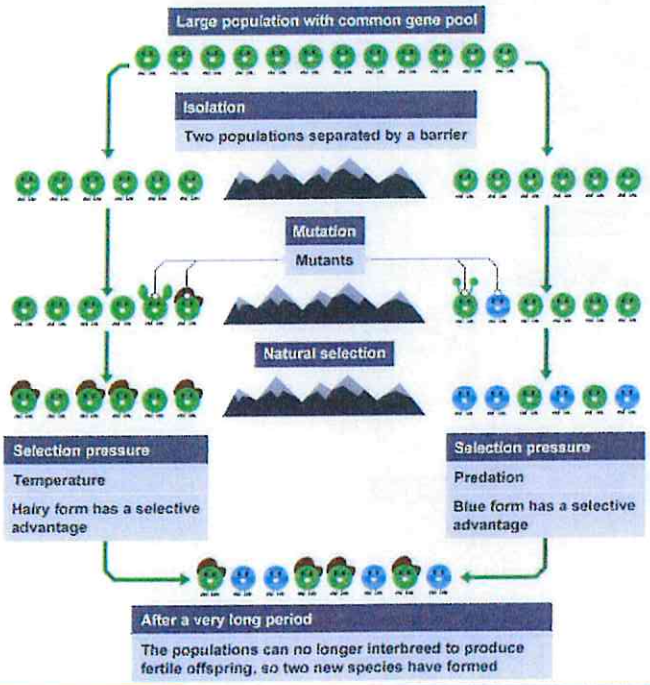
_____

Lesson 9: SPECIATION

1. What is a **species**?

2. What is **speciation**?

3. Using the diagram below, describe the main stages in **speciation**.



Lesson b: SPECIATION

Lemurs are only found on the island of Madagascar.

Madagascar is off the coast of Africa.

Scientists think that ancestors of modern lemurs evolved in Africa and reached Madagascar about 50-60 million years ago.

Today there are many species of lemur living on Madagascar.

Figure 2 shows information about water currents.

Figure 3 shows the distribution of three species of lemur on Madagascar.

Figure 2

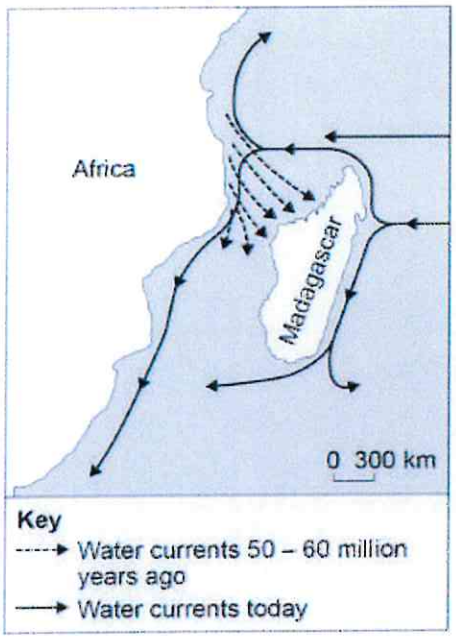
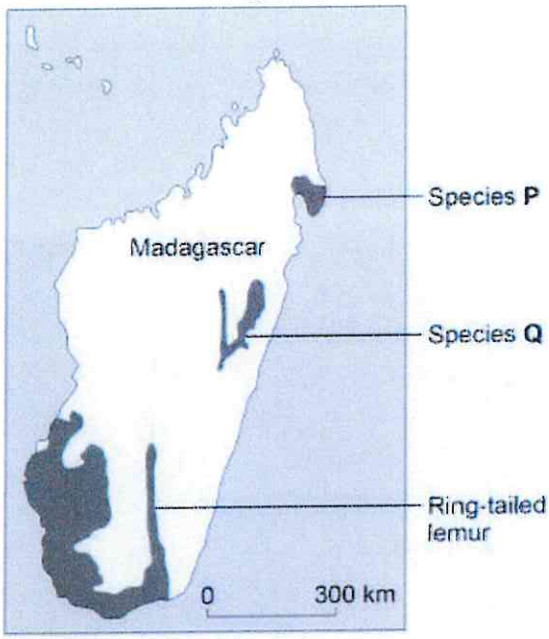


Figure 3



(c) Suggest how ancestors of modern lemurs reached Madagascar.

_____

Describe how the ancestors of modern lemurs may have evolved into the species shown in **Figure 3**.

_____

_____

_____

_____

_____

Lesson c: SPECIATION

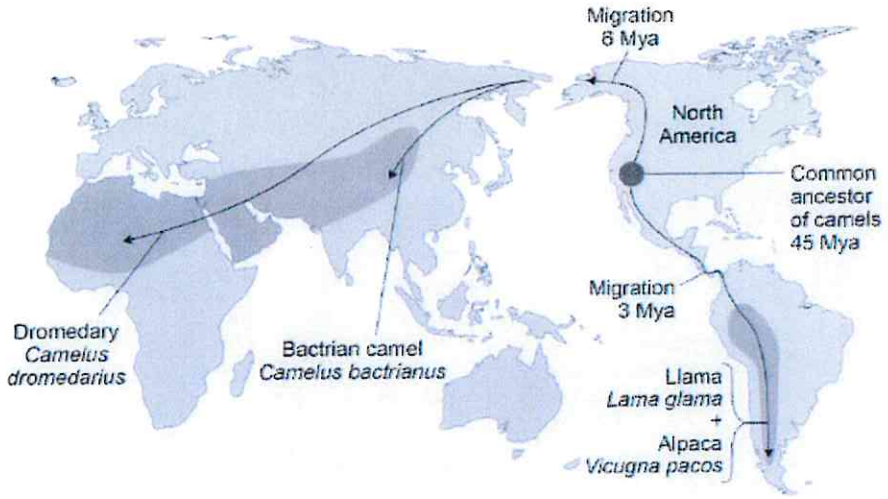
There are several species of the camel family alive today.

Scientists think these species evolved from a common ancestor that lived in North America about 45 million years ago (Mya).

Figure 2 shows:

- where four modern species of the camel family live today
- how the ancestors of these camels migrated from North America.

Figure 2



Explain how several different species of camel could have evolved from a common ancestor over 45 million years (6 marks)

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Lesson 11: GENETIC ENGINEERING

1. What is genetic engineering?

_____

_____

_____

2. What is the genome?

_____

3. What are the stages of genetic engineering?

_____

_____

_____

_____

_____

_____

4.

Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

clones	chromosomes	embryos	genes

GM crops are produced by cutting _____ out of the

_____ of one plant and inserting them into the cells of a crop plant.

(2)

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Lesson 11b: GENETIC ENGINEERING

1. Complete the table of the benefits and risks of genetic engineering.

Benefits	Risks

(2)

2.

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields.
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for a GM crop can only be bought from one manufacturer.
- The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give **two** reasons why some farmers are in favour of growing GM crops.

1. _____

_____

2. _____

Give **two** reasons why many people are against the growing of GM crops. (2)

1. _____

_____

2. _____

_____

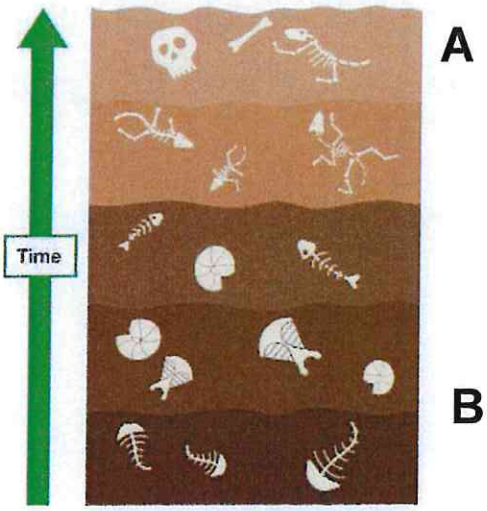
Lesson 12: FOSSILS

1. What is a **fossil**?

_____

_____

2. Describe the 3 main ways in which fossils are formed? Use the diagrams to help you.



3. In which location on the diagram are the most recent **fossils** found?

_____

4. How can **fossils** provide **evidence** about **evolution**?

_____

_____

_____

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Lesson 12b: FOSSILS

Figure 1 shows a fossil of a sea animal called a Plesiosaur.
The Plesiosaur was alive about 135 million years ago.

Figure 1

(a) How can fossils give evidence for evolution?

Tick (✓) **one** box.

Newer fossils are simpler than older fossils. ☐

Fossils show change over time. ☐

All fossils show the bones of animals. ☐

The photograph shows a fossil footprint. The fossil was found in a rock at the bottom of a shallow river.

Scientists believe this is the footprint of a dinosaur. The dinosaur was alive 110 million years ago.

© Pearl Jackson/iStock

(a) (i) Suggest how the fossil shown in the photograph was formed.

_____

_____

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Lesson 13: EXTINCTION

Give **three** reasons, other than volcanic activity and collision with an asteroid, why a species may become extinct.

1. _____

_____

2. _____

_____

3. _____

_____

The dodo became extinct about 80 years after Dutch sailors first discovered the island in the eighteenth century.

Scientists are uncertain about the reasons for the dodo's extinction.

Suggest an explanation for this uncertainty.

_____

_____

Lesson 14: ANTIBIOTIC RESISTANT BACTERIA

1. What is an **antibiotic**?

_____

2. Why can **bacteria** evolve so quickly?

_____

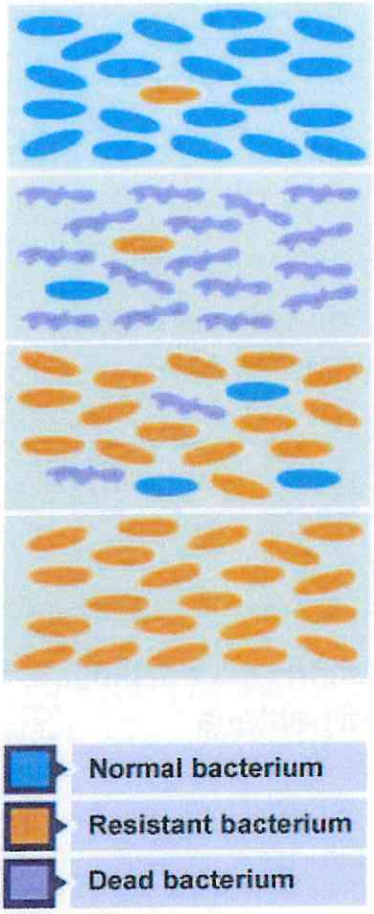
_____

3. Some **bacteria** might become resistant to certain **antibiotics**. What would this mean?

_____

_____

4. Add labels to this diagram to explain how **antibiotic resistant bacteria** can evolve.



5. What is MRSA?

_____

6. How can we prevent the development of **antibiotic resistant** strains of **bacteria**?

_____

_____

_____

_____

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Lesson 14: ANTIBIOTIC RESISTANT BACTERIA

1. What is an **antibiotic**?

Drug that kills bacteria

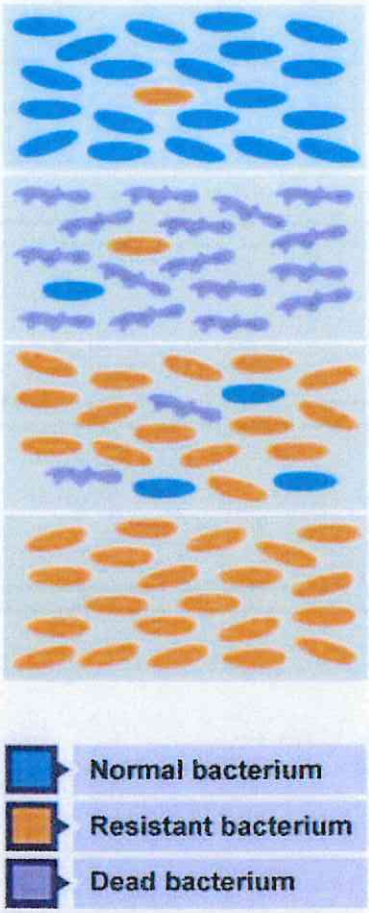
2. Why can **bacteria** evolve so quickly?

Because they reproduce quickly

3. Some **bacteria** might become resistant to certain **antibiotics**. What would this mean?

They would not be killed by the antibiotics

4. Add labels to this diagram to explain how **antibiotic resistant bacteria** can evolve.



Variation within a population of bacteria caused by a mutation.

Antibiotics kill the non-resistant strains. Resistant strains survive.

There is less competition for food, the antibiotic bacteria survive and reproduce.

Resulting population – all antibiotic resistant bacteria

5. What is MRSA?

Antibiotic resistant bacteria.

6. How can we prevent the development of **antibiotic resistant** strains of **bacteria**?

Not to overuse antibiotics (and not use for viral infections)

Complete the course of treatment and restrict agriculture use.

Lesson 14b: ANTIBIOTIC RESISTANT BACTERIA

MRSA strains of bacteria are causing problems in many hospitals.

(a) The diagram shows a hand-gel dispenser.

Hand-gel dispensers are now placed at the entrance of most hospital wards.

Explain why.

_____

_____

_____

_____

(2)

Explain, as fully as you can, how MRSA strains of bacteria became difficult to treat.

_____

_____

_____

_____

_____

_____

(3)

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Lesson 14b: ANTIBIOTIC RESISTANT BACTERIA

Bacteria can evolve rapidly.

Many bacteria can develop into new strains which are resistant to antibiotics.

Complete the table below to show if each action is **more likely** or **less likely** to help bacteria to become antibiotic resistant.

Put a tick in each row.

Action	More likely	Less likely
Take painkillers for headache		
Washing with antiseptic hand gel		
Adding antibiotics to food for cows		
Giving antibiotics for colds and flu		
Stopping antibiotics as soon as you feel better		

Many strains of bacteria have developed resistance to antibiotics.

The table shows the number of people infected with a resistant strain of one species of bacterium in the UK.

Year	2004	2005	2006	2007	2008
Number of people infected with the resistant strain	3499	3553	3767	3809	4131

(a) Calculate the percentage increase in the number of people infected with the resistant strain between 2004 and 2008.

Show clearly how you work out your answer.

_____

_____

Percentage increase = _____

Lesson 15: CLASSIFICATION

1. Which scientist first came up with the traditional idea of classification?

_____

2. Name the 7 divisions of the traditional method of classification in the correct order.

_____
_____
_____
_____
_____
_____
_____

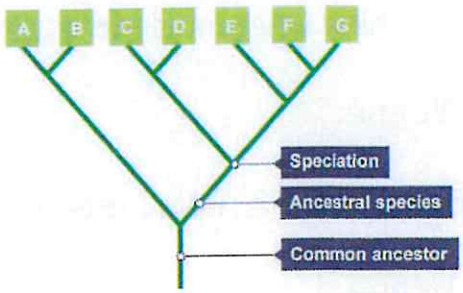
3. Which two parts does the binomial system refer to?

_____ and _____

4. Which scientist developed the 3 domain system?

_____

5. State the 3 main parts of this system.



_____
_____
_____

6 What does an evolutionary tree show?

_____
_____
_____
_____
_____
_____

Lesson 15b: CLASSIFICATION

All living organisms are classified into groups.

Table 1 shows the classification of one species of wheat.

Table 1

Kingdom	Plant
Phylum	Angiosperms
Class	Monocotyledons
Order	Commelinids
Family	Poaceae
Genus	Triticum
Species	spelta

What is the binomial name for the wheat in **Table 1**?

Tick **one** box.

Angiosperm monocotyledons ☐

Poaceae triticum ☐

Species spelta ☐

Triticum spelta ☐

Clesson 15b: LASSIFICATION

Modern classification systems compare the similarity between the DNA of organisms.

The more similar the DNA code, the more closely the organisms are related.

Table 2 shows DNA codes in five different organisms.

Table 2

	DNA Codes									Number of differences in DNA code compared with the human sequence
Human	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	
Pig	J	F	C	D	E	F	G	H	I	
Wheat	C	I	K	D	M	F	G	H	I	
Yeast	C	I	K	D	L	M	G	H	I	5
Chicken	J	F	C	D	M	F	G	H	I	3

(b) Complete the final column of **Table 2** for Pig and for Wheat.

(1)

Which organism in **Table 2** appears to be most closely related to humans?

_____

(1)

Give **one** reason why conclusions about the similarities between organisms should not be made using **only** the DNA codes in **Table 2**.

_____

_____

(1)

Lesson 16: Balancing equations practice

1) ____ $AlBr_3$ + ____ K → ____ KBr + ____ Al

2) ____ FeO + ____ PdF_2 → ____ FeF_2 + ____ PdO

3) ____ P_4 + ____ Br_2 → ____ PBr_3

4) ____ LiCl + ____ Br_2 → ____ LiBr + ____ Cl_2

5) ____ $PbBr_2$ + ____ HCl → ____ HBr + ____ $PbCl_2$

6) ____ $CoBr_3$ + ____ $CaSO_4$ → ____ $CaBr_2$ + ____ $Co_2(SO_4)_3$

7) ____ Na_3P + ____ CaF_2 → ____ NaF + ____ Ca_3P_2

8) ____ Mn + ____ HI → ____ H_2 + ____ MnI_3

9) ____ Li_3PO_4 + ____ NaBr → ____ Na_3PO_4 + ____ LiBr

10) ____ CaF_2 + ____ Li_2SO_4 → ____ $CaSO_4$ + ____ LiF

11) ____ HBr + ____ $Mg(OH)_2$ → ____ $MgBr_2$ + ____ H_2O

12) ____ $LiNO_3$ + ____ $CaBr_2$ → ____ $Ca(NO_3)_2$ + ____ LiBr

13) ____ $AgNO_3$ + ____ Li → ____ $LiNO_3$ + ____ Ag

14) ____ $Si(OH)_4$ + ____ NaBr → ____ $SiBr_4$ + ____ NaOH

15) ____ NaCN + ____ $CuCO_3$ → ____ Na_2CO_3 + ____ $Cu(CN)_2$

Lesson 16: Bbalancing equations practice

1) **1** $AlBr_3$ + **3** K → **3** KBr + **1** Al

2) **1** FeO + **1** PdF_2 → **1** FeF_2 + **1** PdO

3) **1** P_4 + **6** Br_2 → **4** PBr_3

4) **2** LiCl + **1** Br_2 → **2** LiBr + **1** Cl_2

5) **1** $PbBr_2$ + **2** HCl → **2** HBr + **1** $PbCl_2$

6) **2** $CoBr_3$ + **3** $CaSO_4$ → **3** $CaBr_2$ + **1** $Co_2(SO_4)_3$

7) **2** Na_3P + **3** CaF_2 → **6** NaF + **1** Ca_3P_2

8) **2** Mn + **6** HI → **3** H_2 + **2** MnI_3

9) **1** Li_3PO_4 + **3** NaBr → **1** Na_3PO_4 + **3** LiBr

10) **1** CaF_2 + **1** Li_2SO_4 → **1** $CaSO_4$ + **2** LiF

11) **2** HBr + **1** $Mg(OH)_2$ → **1** $MgBr_2$ + **2** H_2O

12) **2** $LiNO_3$ + **1** $CaBr_2$ → **1** $Ca(NO_3)_2$ + **2** LiBr

13) **1** $AgNO_3$ + **1** Li → **1** $LiNO_3$ + **1** Ag

14) **1** $Si(OH)_4$ + **4** NaBr → **1** $SiBr_4$ + **4** NaOH

15) **2** NaCN + **1** $CuCO_3$ → **1** Na_2CO_3 + **1** $Cu(CN)_2$

Lesson 17: Relative formula mass

1. What does a chemical formula tell us?

_____

_____

2. State how many atoms in total and how many of each element are in :

a) H_2O

Total number of atoms =

How many of each element =

b) $CaCO_3$

Total number of atoms =

How many of each elemento =

c) $Mg(OH)_2$

Total number of atoms =

How many of each element =

3. State what the relative formula mass of a substance is:

_____

_____

4. Find the formula mass of the following, show all of your working.

a NH_3

_____

_____

_____

b N_2H_4

_____

_____

_____

c Al_2O_3

_____

_____

_____

Lesson 17

d F_2

e $CuSO_4$

5. Find the formula mass of the following harder chemical examples:

a $Mg(OH)_2$

b $Al(NO_3)_3$

c $KHCO_3$

d NH_4Cl

Lesson 17: Relative formula mass WS

e $Fe_2(SO_4)_3$

f $Ca(HCO_3)_2$

g $(NH_4)_2SO_4$

6. The equation below represents the reaction between methane and oxygen in a combustion reaction.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_20$$

In a balanced chemical equation explain how you can use relative formulas masses to show conservation of mass? Use the equation above to help you explain.

Total relative formula mass of the reactants:

Total relative formula mass of the products:

Lesson 17: Percentage mass WS

7. Calculate the percentage mass of the following elements in the following compounds.

a. Find the % of C in CO_2

b. Find the % of H in H_2O

c. Find the % of Zn in $ZnCO_3$

d. Find the % of Mg in $MgCl_2$

e. Find the % of Pb in PbO_2

f. Find the % of C in CH_4

Lesson 17: Percentage mass WS

g. Find the % of N in NH_4NO_3

h. Find the % of O in C_2H_5OH

i. Find the % of Pb in Pb_2O_3

j. Find the % of O in limestone ($CaCO_3$)

k. Find the % of Fe in iron oxide (Fe_2O_3)

l. Find the % of S in sulphuric acid (H_2SO_4)

Lesson 17: Relative formula mass

1. What does a chemical formula tell us?

_____

_____

2. State how many atoms in total and how many of each element are in :

a) H_2O

Total number of atoms =

How many of each element =

b) $CaCO_3$

Total number of atoms =

How many of each elemento =

c) $Mg(OH)_2$

Total number of atoms =

How many of each element =

3. State what the relative formula mass of a substance is:

_____

_____

4. Find the formula mass of the following, show all of your working.

a NH_3

_____

_____

_____

b N_2H_4

_____

_____

_____

c Al_2O_3

_____

_____

_____

Lesson 17

d F_2

e $CuSO_4$

5. Find the formula mass of the following harder chemical examples:

a $Mg(OH)_2$

b $Al(NO_3)_3$

c $KHCO_3$

d NH_4Cl

Lesson 17: Relative formula mass WS

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$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_20$$

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Total relative formula mass of the reactants:

Total relative formula mass of the products:

Lesson 17: Percentage mass WS

7. Calculate the percentage mass of the following elements in the following compounds.

a. Find the % of C in CO_2

b. Find the % of H in H_2O

c. Find the % of Zn in $ZnCO_3$

d. Find the % of Mg in $MgCl_2$

e. Find the % of Pb in PbO_2

f. Find the % of C in CH_4

Lesson 17: Percentage mass WS

g. Find the % of N in NH_4NO_3

h. Find the % of O in C_2H_5OH

i. Find the % of Pb in Pb_2O_3

j. Find the % of O in limestone ($CaCO_3$)

k. Find the % of Fe in iron oxide (Fe_2O_3)

l. Find the % of S in sulphuric acid (H_2SO_4)

Lesson 18: Mass changes in chemical reactions WS

1) What is conservation of mass?

.....

.....

2) What would appear to happen to mass in a chemical reaction in which a gas is a product? Explain why?

.....

.....

3) What is a closed system? How is conservation of mass proved in any reaction in a closed system?

.....

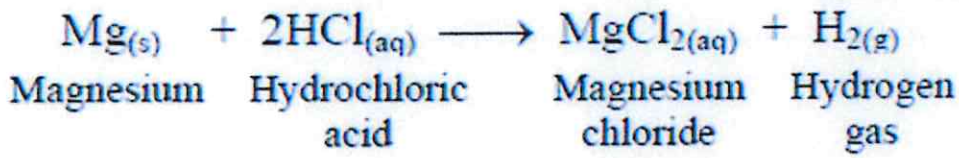
.....

4) What would appear to happen to mass in a chemical reaction in which a gas is a reactant? Explain why?

.....

.....

5) Describe and explain what would appear to happen to mass in the following reaction:



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Lesson 18: Mass changes in chemical reactions WS

6) Practical – Heating Magnesium in air: Fill in the results table and complete the questions afterwards to rehearse your understanding.

Method:

1) Collect and set up apparatus as shown in the diagram.

2) Weigh the mass of the crucible on a top pan balance.

3) Collect a piece of magnesium ribbon and weigh it's mass on an electronic balance.

4) Place a lid on the crucible slightly ajar and heat it a blue "roaring" flame until you see the reaction occur in the crucible (bright light).

5) Leave to cool and then weigh the mass of the crucible plus product (magnesium oxide) using an electronic balance

BEFORE Mass of crucible (g)	BEFORE Mass of magnesium (g)	AFTER Mass of crucible plus product (MgO) (g)	AFTER Mass of product MgO produced (g)

7) What product is formed? What happens to the mass of product compared to the mass of magnesium reactant used?

.....

.....

8) Describe what this change in mass shows and what does it prove?

.....

.....

.....

Lesson 19: chemical measurements WS

1) What is the mean of the following data? (12m, 17m, 12m 11m)

.....

.....

2) What is the resolution of a piece of measuring equipment?

.....

.....

3) What is the resolution of a thermometer, which has readings at 10. 11, 12, 13, 14 and 15 degrees?

.....

4) Define what the range of data is?

.....

5) What is the range of date in the table?

Length of pendulum - .....

Time taken for swing - .....

Length of pendulum/cm	Time taken to complete 1 swing/s
10	0.63
20	0.90
30	1.10
40	1.27
50	1.42

6) Describe what uncertainty is in experimental results?

.....

.....

.....

7) Explain what you need to do to calculate the uncertainty of experiment results?

.....

.....

Lesson 19: hemical measurements WS

8) What is the uncertainty of the following experiment results?

Test	1	2	3	4	5
Distance (cm)	23	25	21	21	20

.....
.....
.....

9) A ruler has a reading every 2cm. What is the uncertainty of a reading of 16cm?

.....
.....
.....

Lesson 20: Concentration calculations

1) Describe what a solution is?

2) Explain what concentration is and give it's correct units?

3) State the equation used to calculate concentration?

4) Use the equation to work out the concentration of the following? (show working out)

a) 10g of magnesium chloride in 1dm^3 of solution

b) 1.5g of potassium iodide in 2dm^3 of solution

c) 2.3g of lithium chloride in 0.5dm^3 of solution

Lesson 20: Concentration calculations

5) Rearranging the equation: Use the equation to work out the mass required to make the following solutions? (show working out)

a) 0.5dm^3 of a 2g/dm^3 solution of silver nitrate

b) 0.25dm^3 of a 1.5g/dm^3 solution of sodium chloride

c) 0.1dm^3 of a 0.4g/dm^3 solution of sodium carbonate

6) Rearranging the equation: Use the equation to work out the volume required to make the following solutions? (show working out)

a) 2g of a 2g/dm^3 solution of silver nitrate

b) 6g of a 1.5g/dm^3 solution of sodium chloride

Lesson 20: Limiting reactants WS 1

c) 0.2g of a 0.4 g/dm^3 solution of sodium carbonate

7) Interconverting units:

Use the equation to work out the following questions? (show working out)

a) The concentration of the solution in g/dm^3 : 1.5g of potassium iodide in 150cm3 of solution.

b) The mass in grams needed to make the following solution: 250 cm^3 of a 1.5g/dm^3 solution of sodium chloride.

Concentration calculations (HIGHER LEVEL ONLY)

1) Describe what concentration is moles is.

2) What is the equation to calculate concentration in moles/ dm^3 ?

3) Use the equation to work out the concentration of the following solutions (show your working)

a) 4 moles dissolved in 8 of dm^3 solution

b) 0.36 moles dissolved in 0.25 dm^3 of solution

c) 0.1 moles dissolved in 50 cm^3 of solution (check units..)

4) (REARRANGE) Use the equation to work out the number of moles of solute in the following solutions (show your working)

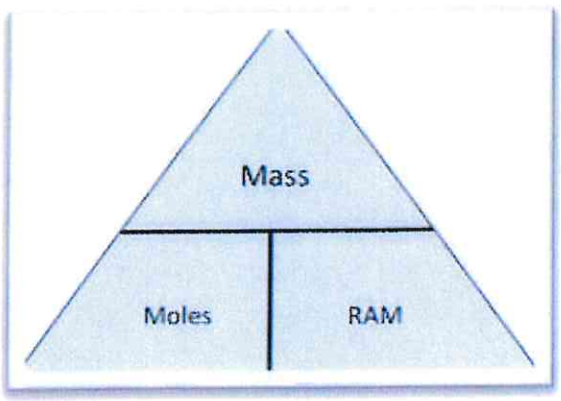
a) 4dm^3 of 0.30mol/dm^3 solution

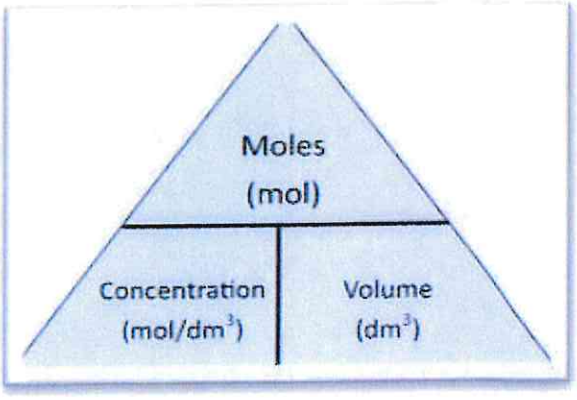
Concentration calculations HIGHER LEVEL ONLY)

b) $0.25dm^3$ of $1.50mol/dm^3$ solution

5) Calculate the concentration in g/dm^3 of a solution of HCl of concentration $0.20mol/dm^3$?

6) Calculate the concentration in mol/dm^3 of a solution of HCl of concentration $50g/dm^3$?





Lesson 22: Potable water

What is a potable water?

What is the difference between potable water and pure water?

What are the requirements for potable water?

What can potable water be produced from?

What is fresh water and where is it found?

What is the preferred method to produce potable water and why?

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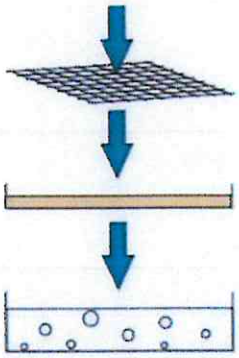
Lesson 22: Potable water

Use the diagram to answer the following questions

Name the stages in the production of potable water from fresh water.



_____

_____

Describe each step involved in producing potable water from fresh water and explain why it is used

Step 1 Description:

_____

_____

Step 1 Explanation:

_____

_____

Step 2 Description:

_____

_____

Step 2 Explanation:

_____

_____

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Lesson 22: Potable water

For what reason would sea water be used to produce potable water?

_____

What are the methods to produce potable water from sea water?

_____

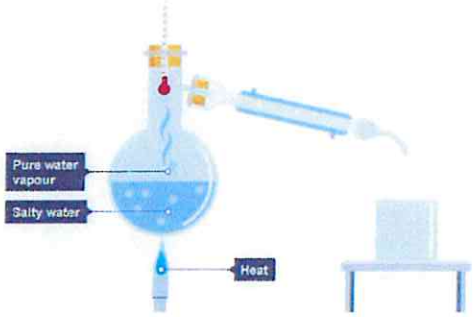
_____

What are these not the preferred methods to produce potable water?

_____

_____

Use the diagram to describe the steps involved in distillation?



_____

_____

_____

_____

_____

_____

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Lesson 23: Waste water treatment

What does industrial waste water contain?

_____

_____

What does sewage water from homes and agricultural waste water contain??

_____

_____

Name stage one in the treatment of sewage water.

_____

Explain what happens in stage one.

_____

_____

_____

Name stage two in the treatment of sewage water?

_____

Use the diagram to explain what happens during stage two of the process.

_____

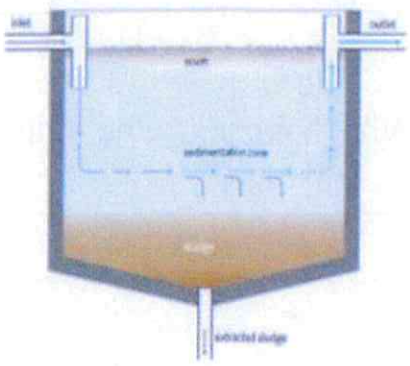
_____

_____

_____

_____

_____



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Lesson 23: Waste water treatment

What is the effluent and where is it found and where does it go after treatment?

What is the sludge and where is it found?

Explain how the effluent is treated?

Explain how the sludge is treated?

What happens to the effluent and sludge once they have been treated?

Lesson 24: Life cycle assessment

What does a life cycle assessment do?

Complete the table below with the stages of the life cycle assessment and the factors that need to be considered at each stage .

Life cycle assessment stage	Factors that need to be considered during this stage.

A life cycle assessment is not completely objective. What do we mean by this statement?

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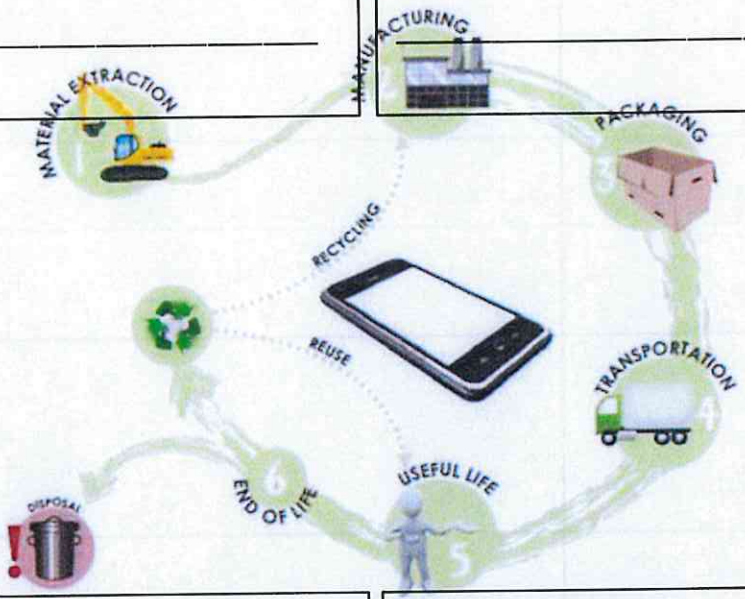
Lesson 24: Life cycle assessment

The picture represents a life cycle assessment for a mobile phone. Complete each box to explain the environmental impact of each stage of the life cycle.

Raw materials – plastic and metal

Manufacturing and packaging



Using the product

Product disposal

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Lesson 24: Life cycle assessment

Below is a life cycle assessment comparing a plastic bag with a paper bag.

Life cycle assessment stage	Plastic bag	Paper bag
Raw material	Crude oil	Timber
Manufacturing and packaging	Fractional distillation of crude oil. Cracking of long chains Polymerisation reaction Other products also have uses.	Timber is pulped, large energy requirement for this. Lots of waste made which needs disposal.
Using the product	Can be reused.	Usually used once.
Product disposal	Can be recycled. Not biodegradable	Can be recycled. Not biodegradable.

Student A claims we should use paper bags because they come from trees and are biodegradable. Student B claims we should use plastic bags because they can be reused. Which student is correct? Explain your choice by evaluating by the life cycle assessments.

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Lesson 25: Ways of reducing the use of resources

Why do we need to reduce the use of the Earth's resources?

How do we reduce the use of Earth's limited resources?

What is the difference between recycling and reusing?

Why are metals recycled?

How are metals recycled?

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Lesson 25: Ways of reducing the use of resources

What are the advantages and disadvantages of recycling metals?

How do we reduce the amount or iron needed to be extracted from iron ore?

How is glass recycled?

Lesson 26: Longitudinal and Transverse Waves

1) What is a transverse wave?

_____

_____

2) Name 2 examples of transverse waves.

_____

3) What is a longitudinal wave?

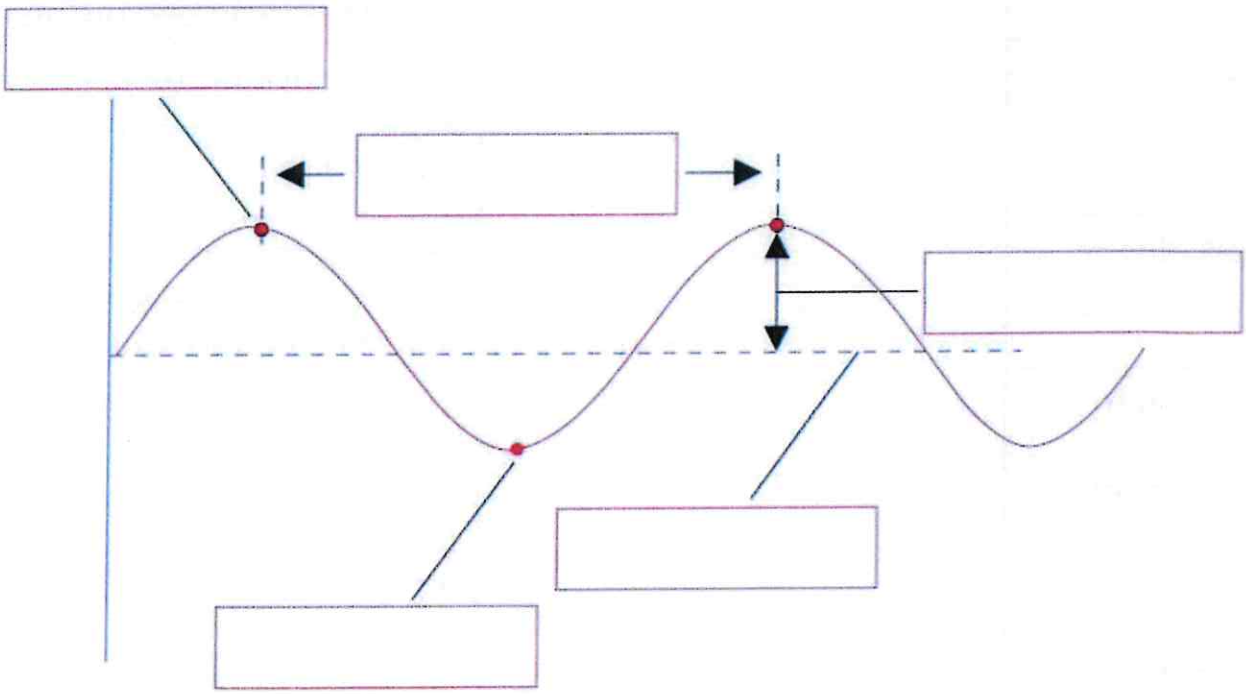
_____

_____

4) Name 2 examples of longitudinal waves.

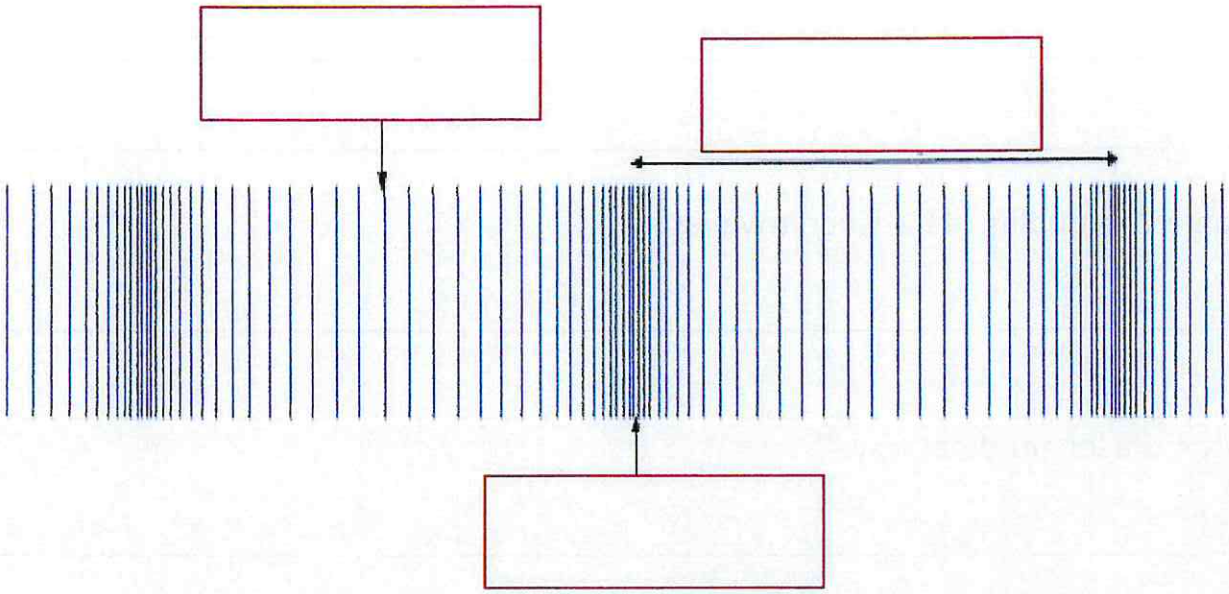
_____

5) Label the Transverse wave below:



Lesson 26: Longitudinal and Transverse Waves

6) Label the Longitudinal wave below:



7) Match the following words with their correct definitions.

Word	Definition
Crest	The maximum displacement of a point on a wave away from its undisturbed position.
Trough	Regions of low pressure due to particles being spread further apart.
Amplitude	The distance from a point on one wave to the equivalent point on the adjacent wave.
Wavelength	The highest point in a wave.
Compression	Regions of high pressure due to particles being close together.
Rarefaction	The lowest point in wave.

Lesson 26: Longitudinal and Transverse Waves

8) Describe the difference between longitudinal and transverse waves.

9) What evidence confirms that waves transfers energy and not matter?

Lesson 27: Properties of Waves

1) Define frequency.

_____

_____

2) Define time period.

_____

_____

3) What is the frequency of a paddle that vibrates 10 times in 10 seconds?

_____

4) Calculate the frequencies of the following waves:

a) A wave with a time period of 2 seconds.

b) A wave with a time period of 0.004 seconds.

c) A wave with a time period of 0.5 hours.

5) Calculate the time periods of the following waves:

a) A wave with a frequency of 15 Hz.

b) A wave with a frequency of 2 KHz.

c) A wave with a frequency of 0.1 Mhz.

Lesson 27: Properties of Waves

6) What is the equation that links wave speed, frequency and wavelength?

---

7) Calculate the **wave speed** (in m/s) for the following waves:

a) A sound wave in steel with a frequency of 500 Hz and a wavelength of 3.0 metres.

b) a ripple on a pond with a frequency of 2 Hz and a wavelength of 0.4 metres.

c) A radio wave with a wavelength of 30 m and a frequency of 10,000,000 hertz.

8) Calculate the **wavelength** (in metres) for the following waves:

a) A wave on a slinky spring with a frequency of 2 Hz travelling at 3 m/s.

b) An ultrasound wave with a frequency 40,000 Hz travelling at 1450 m/s in fatty tissue.

c) A sound wave with frequency 440 Hz travelling at 340 metres per second in air.

9) Calculate the **frequency** (in Hz) for the following waves:

a) A sound wave of wavelength 10 metres travelling at 340 metres per second in air.

b) A wave on the sea with a speed of 8 m/s and a wavelength of 20 metres.

c) A microwave of wavelength 0.15 metres travelling through space at 300,000,000 m/s.

Lesson 27: Properties of Waves

Exam Questions.

1. A note was played on an electric keyboard. The frequency of the note was 440 Hz

(a) (i) What does a frequency of 440 Hz mean?

_____

_____

(1)

(ii) The sound waves produced by the keyboard travel at a speed of 340 m / s.
Calculate the wavelength of the note.

Give your answer to **three** significant figures.

_____

_____

_____

Wavelength = _____ metres

(3)

2. A lorry has an air horn. The air horn produces sound waves in the air.

(a) Use **one** word to complete the following sentence.

Sound waves cause air particles to _____ .

(1)

(b) The air horn produces sound waves at a constant frequency of 420 Hz.
The wavelength of the sound waves is 0.80 m.

Calculate the speed of the sound waves.

_____

_____

_____

Speed = _____ m/s **(2)**

Lesson 28: Ripples on the surface of water – Required practical

Hypothesis:

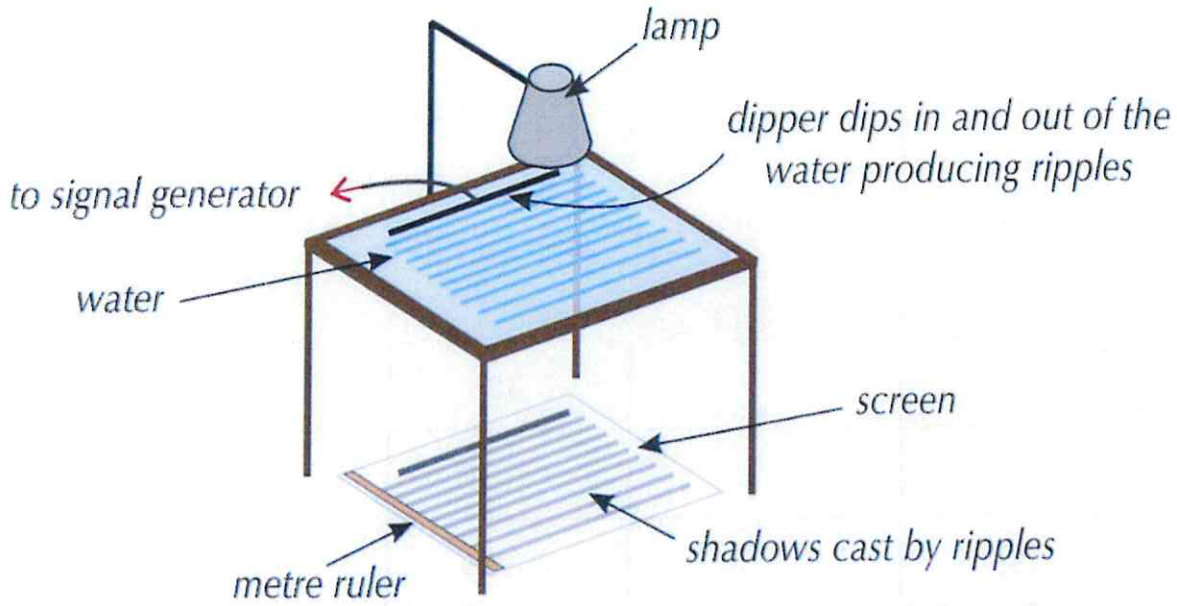
.....

.....

.....

Method:

Figure 1:



1. Set up the ripple tank shown in figure 1. (diagram on previous page)
2. Count the number of waves that pass a given point every 10 seconds. Record your results.
3. Divide by 10 to get the numbers of waves per second. This is the frequency.
4. Measure the length of 10 waves. Record your results.
5. Divide by 10 to get length of one wave. This is the wavelength.
6. Change the frequency and take the measurements again .
7. Repeat this until you have at least six sets of results.
8. Calculate the wave speed using the equation: wave speed = frequency x wavelength.

Lesson 28: Ripples on the surface of water – Required practical

My result from ripple tank video

Result	Number of waves in 10 seconds	Wave Frequency (Hz) – number of waves in 1 second	Length of 10 waves (m)	Wavelength (m) – length of 1 wave	Speed (m/s)
From video					

Exemplar Results

Result	Number of waves in 10 seconds	Wave Frequency (Hz) – number of waves in 1 second	Length of 10 waves (m)	Wavelength (m) – length of 1 wave	Speed (m/s)
1	115		0.385		
2	135		0.335		
3	155		0.300		
4	173		0.240		
5	191		0.210		
6	211		0.190		

Conclusion

.....

.....

.....

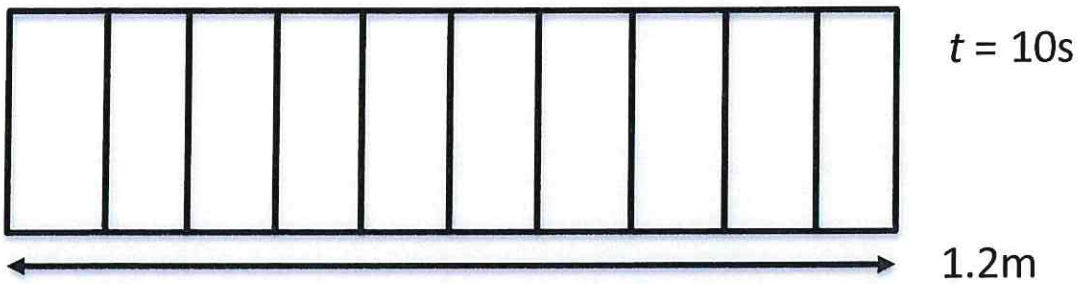
Lesson 28: Ripples on the surface of water – Required practical

Post practical questions.

1. Describe an experiment to find the speed of a wave through water.

2. What are the units for frequency? _____.

Look at the following ripple tank.



3. Use the diagram to find the approximate wavelength.

4. Calculate the frequency of the waves.

5. Use this information to find the wave speed

Lesson 28b: Required practical – Waves through a solid

Hypothesis:

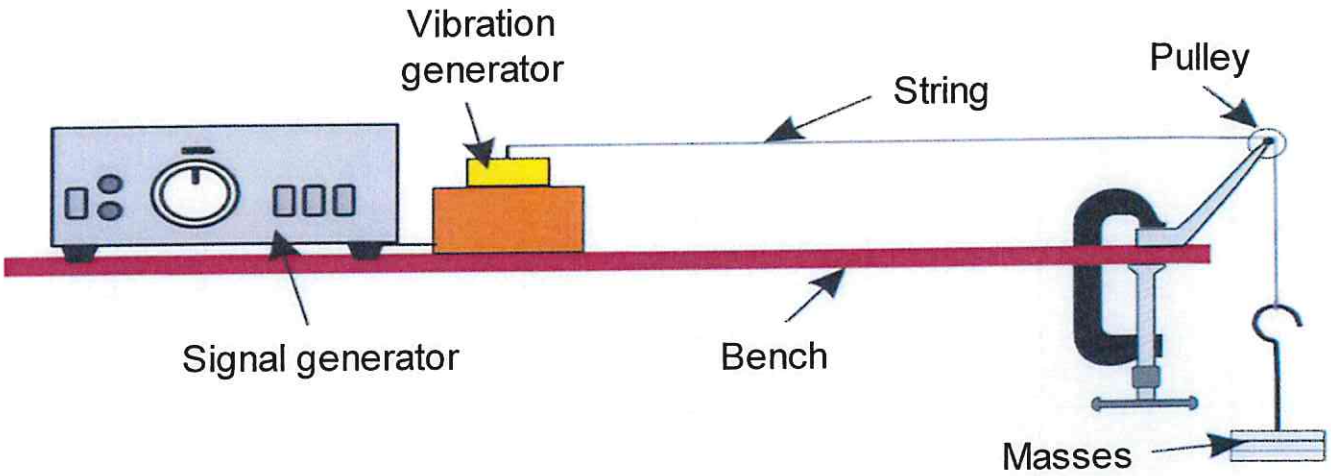
.....

.....

.....

Method:

Figure 1:



1. Set up the equipment as shown in figure 1.
2. Turn on the signal generator and the attached string will start to vibrate up and down.
3. Move the wooden bridge until it looks like the waves are no longer moving and you see a standing wave.
4. Record the length of as many half wavelengths are on your string.
5. Divide the total length of those wavelengths by the number of half wavelengths, and then double this. You will now have the wavelength of one full wave.
6. Record the frequency of the signal generator.
7. Calculate the wave speed using the equation: wave speed = frequency x wavelength.
8. Change the frequency on the signal generator and repeat steps 2 – 6 twice more.

Results table

Wave Frequency (Hz)	Total wave distance (m)	Number of half wavelengths (m)	Distance of one half wavelength (m)	Wavelength (m)	Speed (m/s)

Conclusion

.....

.....

.....

Lesson 28b: Ripples on the surface of water – Required practical

1) Calculate your mean speed of the wave through the string.

2) What is the range in your speeds?

3) Why do we need to count over many half wavelengths, rather than measuring the length of a signal wavelength?

4) Complete the risk assessment below for this experiment

Hazard	Risk	Control

Lesson 28c: Sound waves through air

1) What are the 3 ways we can measure the speed of sound in air?

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Lesson 28c: Sound waves through air

All calculations must show full working out for the marks

2) A lightning bolt hits the ground 4 km away from where you are. It takes 12 seconds for the sound to of the fire work to reach you. What is the speed of sound?

3) A race is started when a person shoots a pistol into the air. You are stood at the finish line 1km away. You see the man fire the pistol into the air but don't hear the pistol until 3 seconds into the race. How fast is the speed of sound?

4) A person claps 350 m away from of a mountain. He hears an echo 2.1 second later. What is the speed of sound?

5) A women hits a drum. At the same time a stopwatch is started. An echo of the sound is heard 0.5 a second later. What is the speed of sound if the echo reflected off a wall 80 m away?

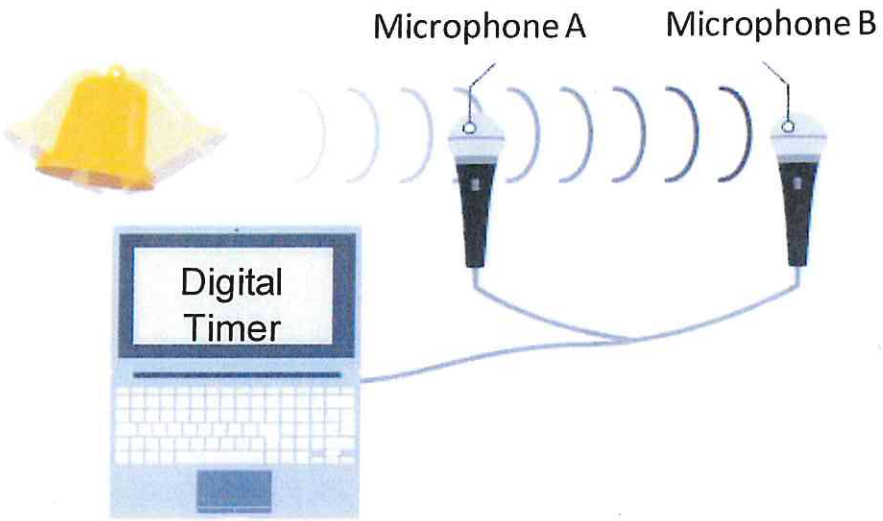
6) Why do you think that the answer to number 5 isn't as close to the speed of sound (340 m/s) as some of the other answers?

_____

_____

Lesson 28c: Sound waves through air

7) Two microphones are connected to a digital timer. When a bell is rand the timer will record how long it takes for the sound to get from microphone A to microphone B.



a) If microphone B is 2.00 metre further away from the source of sound than microphone A, and the clock records a time of 6.0 milliseconds. What is the speed of the sound wave.

b) If microphone B is 0.5 metre further away from the source of sound than microphone A, and the clock records a time of 1.5 milliseconds. What is the speed of the sound wave.

c) If microphone B is 10 cm further away from the source of sound than microphone A, and the clock records a time of 0.3 milliseconds. What is the speed of the sound wave.

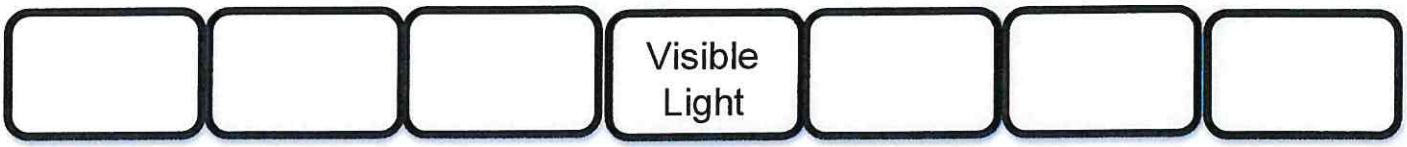
8) Why might the method used in question 7 be a better method to use that the other methods used.

_____

_____

Lesson 29: Type of Electromagnetic Waves

1) Complete the diagram below of the electromagnetic spectrum, below:



2) Which Electromagnetic wave has:

a) The lowest energy _____

b) The highest energy _____

c) The longest wavelength _____

d) The shortest wavelength _____

e) The lowest frequency _____

f) The highest frequency _____

3) What is the speed of all waves in the electromagnetic spectrum?

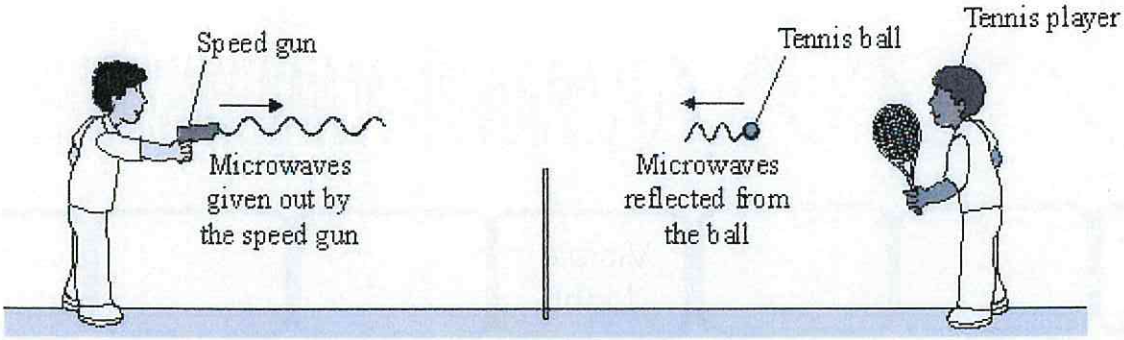
_____

4) What do all types of electromagnetic wave transfer from one place to another?

_____

Lesson 29: Type of Electromagnetic Waves

5) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



a) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Calculate the wavelength of the microwaves emitted from the speed gun. Show clearly how you work out your answer.

_____

_____

_____

Wavelength = _____ m

b) Some of the microwaves transmitted by the speed gun are absorbed by the ball. What effect will the absorbed microwaves have on the ball?

_____

_____

Lesson 29: Type of Electromagnetic Waves

6) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B** or **C**, is an infra red wave? _____

7) Radio waves, ultra-violet, visible light and X-rays are all types of electromagnetic radiation.

Choose wavelengths from the list below to complete the table.

3×10^{-8} m **1×10^{-11} m** **5×10^{-7} m** **1500 m**

TYPE OF RADIATION	WAVELENGTH (m)
Radio waves	
Ultra-violet	
Visible light	
X-rays	

8) Microwaves are another type of electromagnetic radiation. Calculate the frequency of microwaves of wavelength 3 cm. (The velocity of electromagnetic waves is 3×10^8 m/s.)

_____

_____

_____

Frequency = _____ m

Lesson 2a: COMPARING MITOSIS AND MEIOSIS

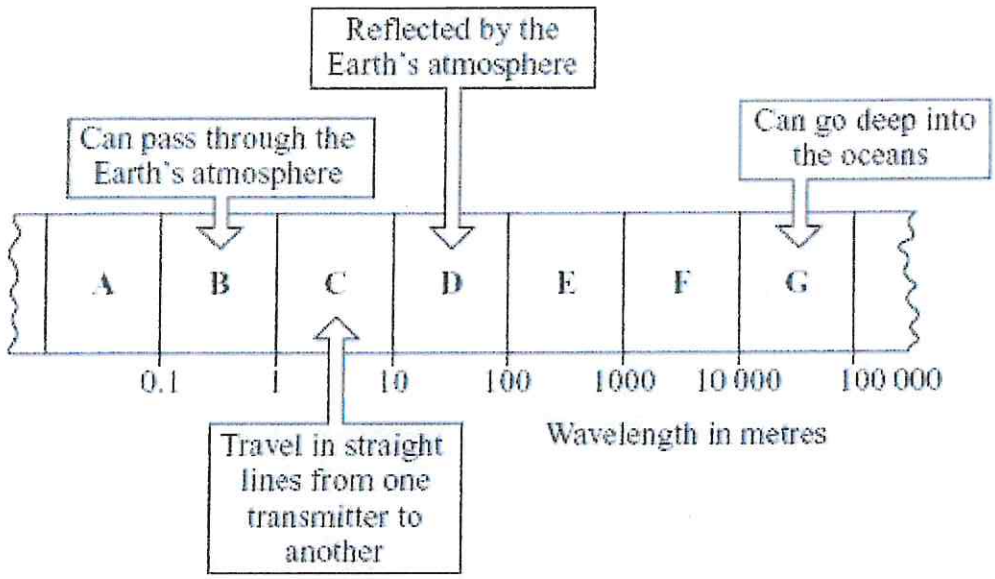
1. Complete the comparison table

	Mitosis	Meiosis
Role		
Number of divisions		
Genetically identical?		
Number of daughter cells?		
Asexual or sexual?		
Number of chromosomes in daughter cells		

2. Using your table to help, compare the two processes of **mitosis** and **meiosis**.

Lesson 31: Uses and Applications of Electromagnetic waves

3) The diagram shows a small part of the electromagnetic spectrum divided into seven sections. The different properties of the waves in each section make them useful in different ways.



The waves in which section, **A**, **B**, **C**, **D**, **E**, **F** or **G**, are:

(a) used to send a signal to a satellite in space _____ (1)

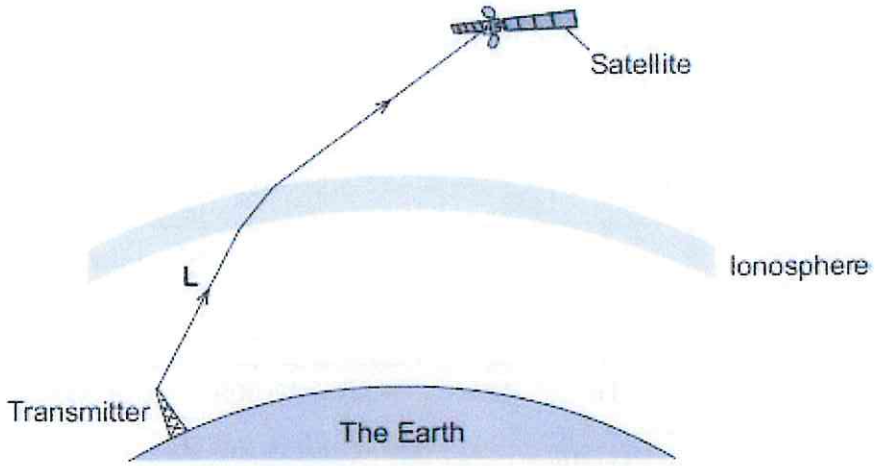
(b) used to communicate with a submarine under the water _____(1)

(c) used by a radio station to broadcast programmes around the world _____ (1)

(d) the waves with the shortest wavelength?_____ (1)

2 **Figure 2** shows a transmitter sending a signal to a satellite orbiting the Earth.

Figure 2



a) Which type of electromagnetic wave is used to send a signal to a satellite?
Draw a ring around the correct answer.

gamma **microwave** **ultraviolet**

(1)

b) After a person is injured a doctor will sometimes ask for a photograph to be taken of the patient's bone structure, e.g. in the case of a suspected broken arm.

(i) Which type of electromagnetic radiation would be used to take the photograph?

_____ (1)

(ii) Describe the properties of this radiation which enable it to be used to photograph bone structure.

_____

_____

_____

_____

(2)

Lesson 31: Uses and Applications of Electromagnetic waves

Exam questions

1. The figure below shows an incomplete electromagnetic spectrum.

A	microwaves	B	C	ultraviolet	D	gamma

(a) What name is given to the group of waves at the position labelled A in the figure above?

Tick **one** box.

infrared ☐ radio ☐ visible light ☐ X-ray ☐

(b) Electromagnetic waves have many practical uses.

Draw **one** line from each type of electromagnetic wave to its use

Electromagnetic wave	Use
Gamma rays	For fibre optic communications
Microwaves	For communicating with a satellite
Ultraviolet	To see security markings
	To sterilise surgical instruments

Lesson 31: Uses and Applications of Electromagnetic waves

1) Complete the Table below:

Most Energy ↓ Least Energy	Type of EM radiation	Applications of the wave (uses)	Why is this type of radiation suitable?

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Lesson 30: Refraction

1) Draw a ray diagram to represent the descriptions below. Remember to include the normal line and label the angle of incidence and angle of refraction. All rays are coming into the block at an angle from the normal.
(Order of density from most to least dense: Glass → Water → Air)

A ray of light passing from air into water. *Air*	A ray of light passing from water into air. *Water*
Water	*Air*
A ray of light passing from glass into air. *Glass*	A ray of light passing from air into water and then into glass. *Air*
Air	*Water*
	Glass

2) What are the three things a wave can do when it his a boundary between two different mediums?

- _____
- _____
- _____

3) Why does refraction happen to a wave?

4) When a wave goes into a block at right angles to the surface refraction does not happen. Why?

5) James set up an experiment as shown below:

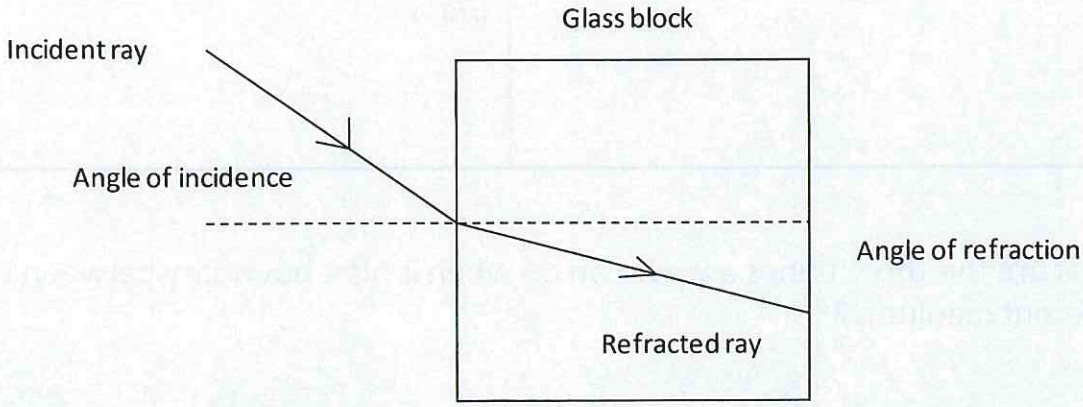
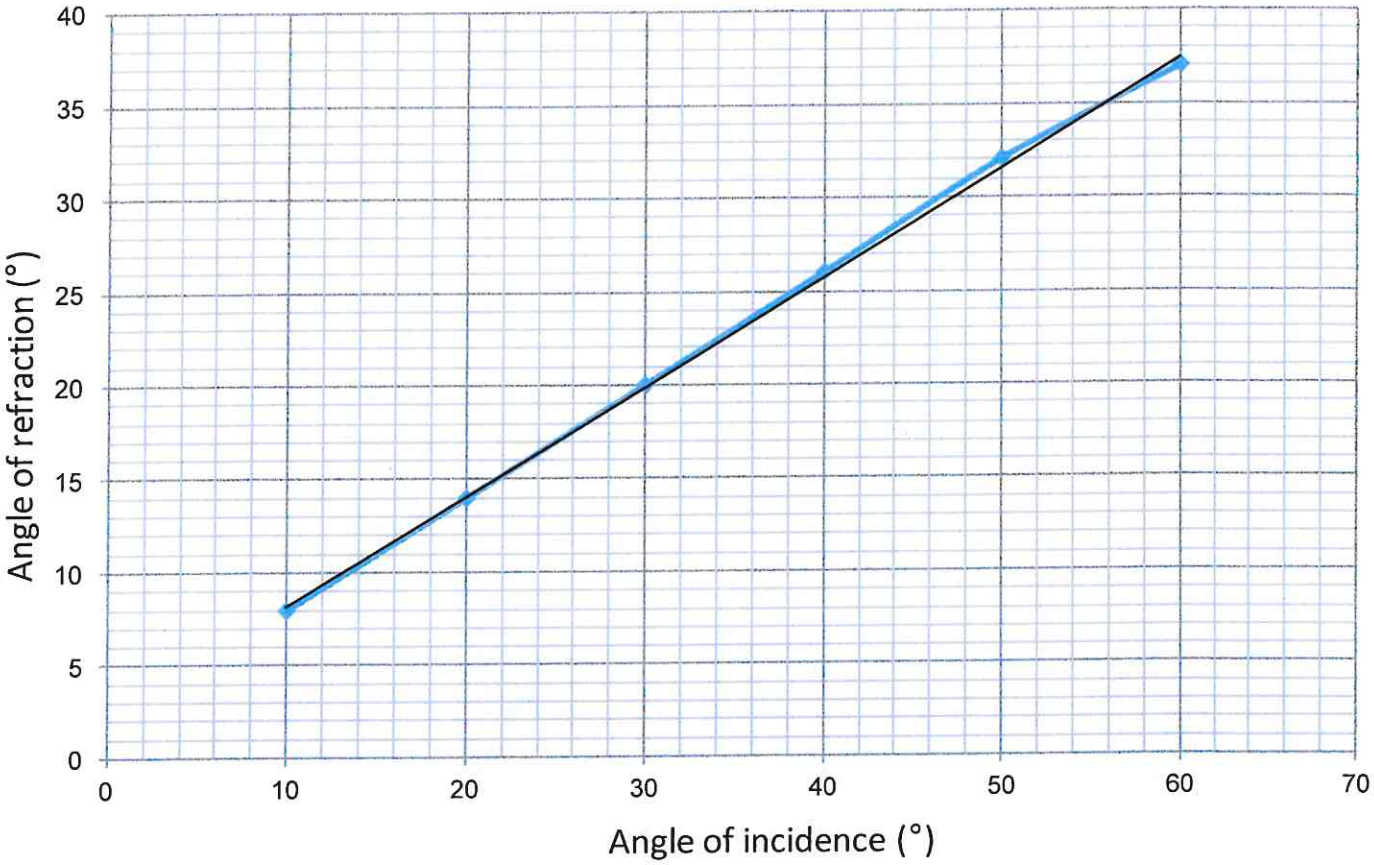


Diagram 2

Lesson 30: Refraction

He measured the angle of refection for different angles of incidence.
His results are shown in the graph.



a) Use the graph to answer the questions below:
When the angle of refraction is 20°, what is the angle of incidence?

.....°

b) What conclusion could James draw from his graph?

When light passes from air into glass, the angle of incidence is always
..... the angle of refraction.

Lesson 30: Refraction

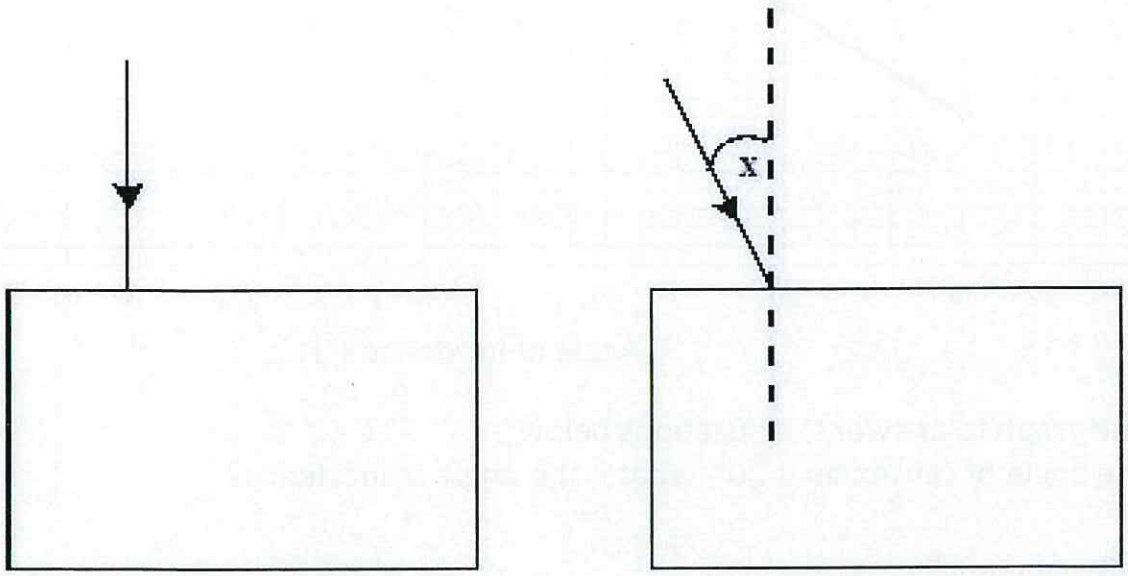
Exam questions

Q1.(a) The diagrams show rays of light. Each ray strikes a surface of a glass block.

i) On the diagrams draw the path of each ray through the glass block and out into the air again.

ii) Label another angle on the diagram which is equal to the angle marked **X**.
Label this angle **Y**.

(4)

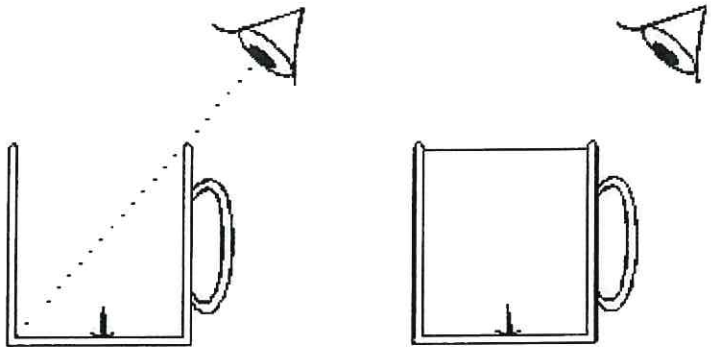


. Complete the ray diagram below.

Lesson 30: Refraction

Exam questions

b) The diagrams show two beakers. Both beakers have a drawing pin inside as



The first beaker is empty. The eye cannot see the drawing pin.
The second beaker is full of water and the eye can see the drawing pin.
Explain how the eye is able to see the drawing pin in the second beaker. You may add to the diagram if it helps your answer. **(3)**

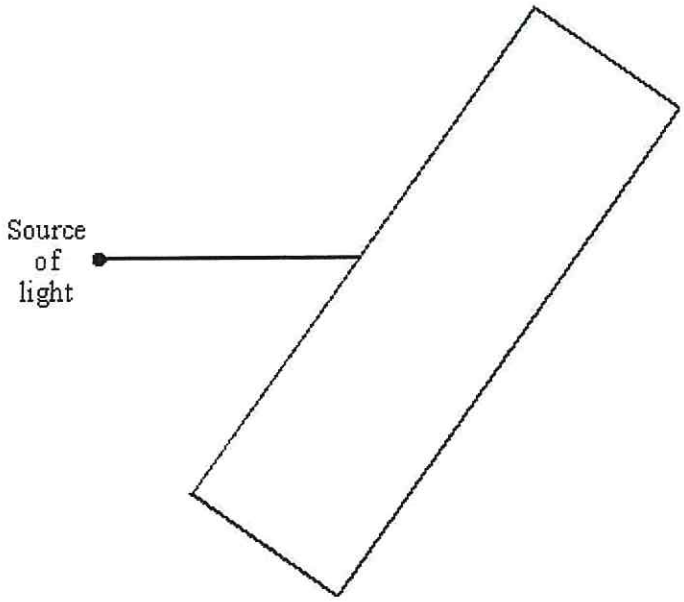
_____

_____

_____

2) Light can also be made to change direction as it passes into and out from a block of glass. Complete the ray diagram below.

(2)



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	Glass

2) What are the three things a wave can do when it his a boundary between two different mediums?

- _____
- _____
- _____

Lesson 30: Refraction

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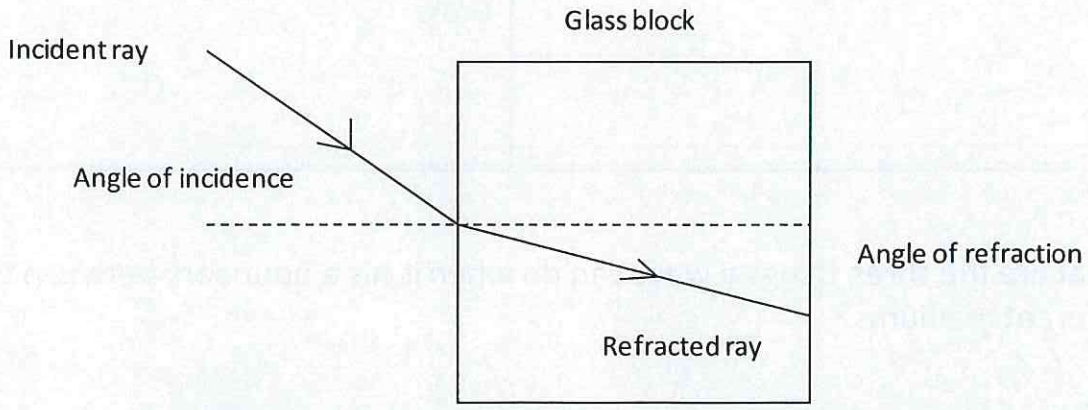

Diagram 2

Lesson 30: Refraction

He measured the angle of refection for different angles of incidence.
His results are shown in the graph.

a) Use the graph to answer the questions below:
When the angle of refraction is 20^0, what is the angle of incidence?

.....^{o}

b) What conclusion could James draw from his graph?

When light passes from air into glass, the angle of incidence is always
..... the angle of refraction.

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Lesson 30: Refraction

Exam questions

Q1.(a) The diagrams show rays of light. Each ray strikes a surface of a glass block.

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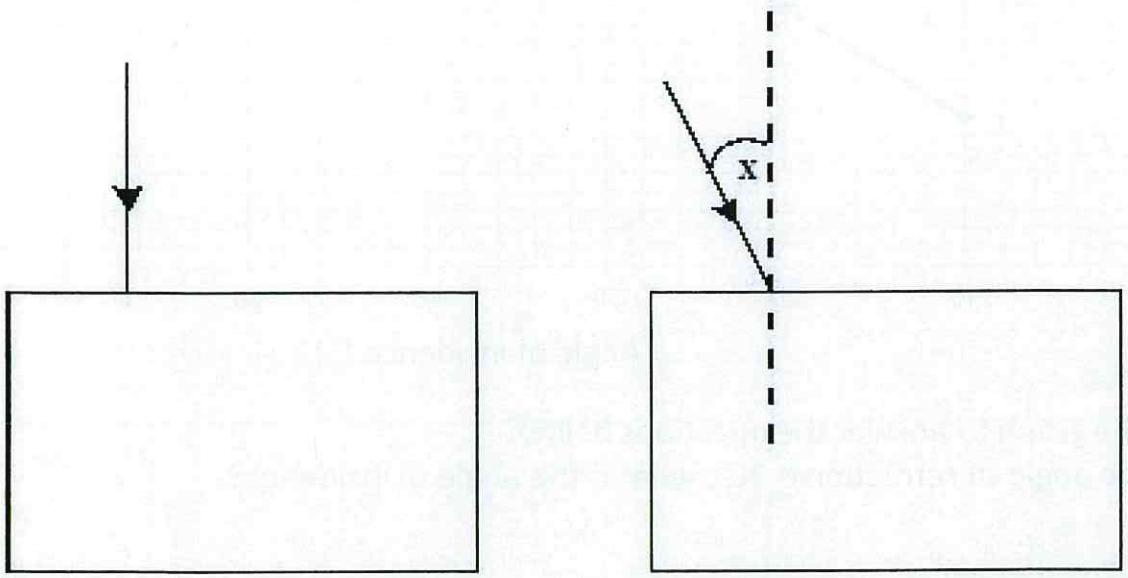
(4)



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Lesson 30: Refraction

Exam questions

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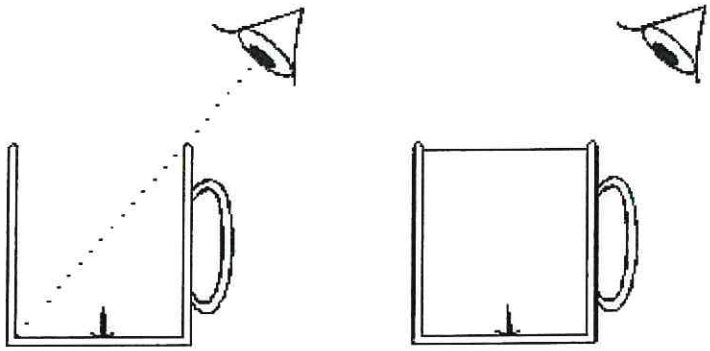

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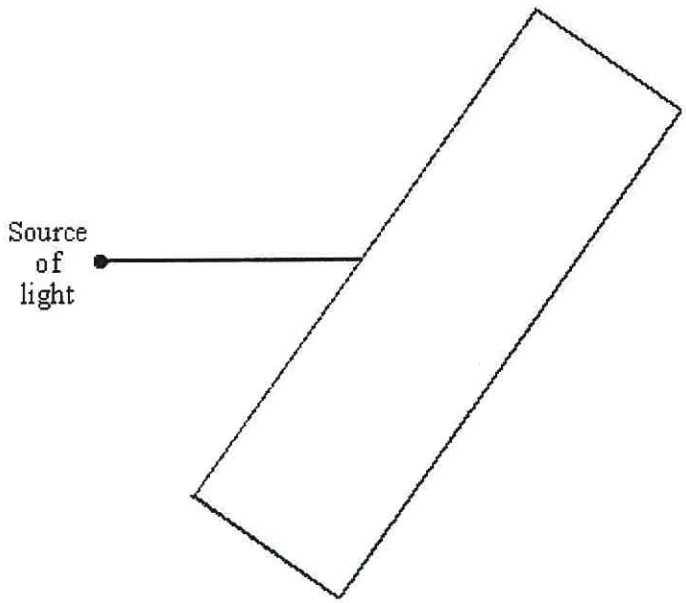
Explain how the eye is able to see the drawing pin in the second beaker. You may add to the diagram if it helps your answer. **(3)**

2) Light can also be made to change direction as it passes into and out from a block of glass. Complete the ray diagram below.

(2)



Lesson 3b: HUMAN GENOME PROJECT

1. Define the term genome.

2. Why is the human genome project important.

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Out of lesson

Answers Science

Term 1

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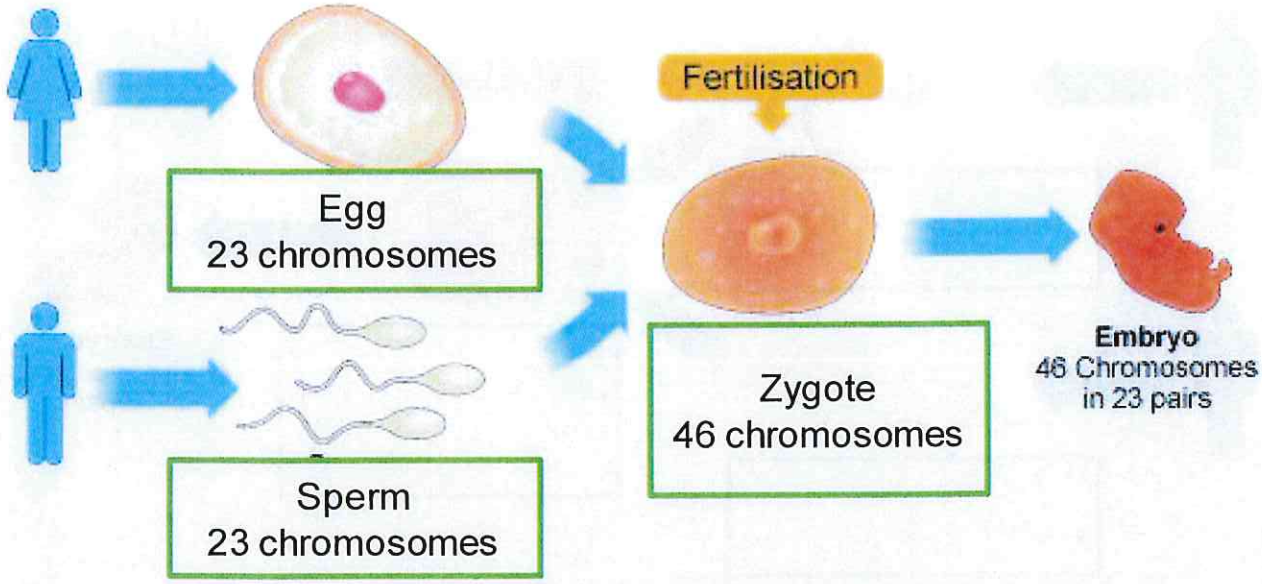
Lesson 1: SEXUAL AND ASEXUAL REPRODUCTION

1. Label the diagram.



2. Explain in your own words what the above diagrams shows

- The nuclei of the **sperm** cell and the **egg** cell fuse together at **fertilisation**.
- They each contain 23 chromosomes.
- This makes a zygote (fertilised egg cell) with 46 chromosomes, arranged in 23 pairs.

3. Why is there variation in sexual reproduction?

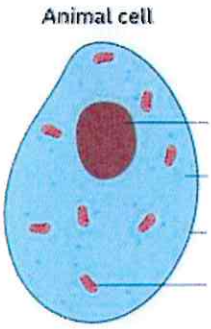
- There is mixing of the genetic material when the two **gametes** fuse at **fertilisation**.

4. Complete the table.

	Sexual	Asexual
How many parents?	2	1
Does it create **variation**?	yes	No
Does it involve **gametes**?	yes	No
Examples include?	humans	bacteria

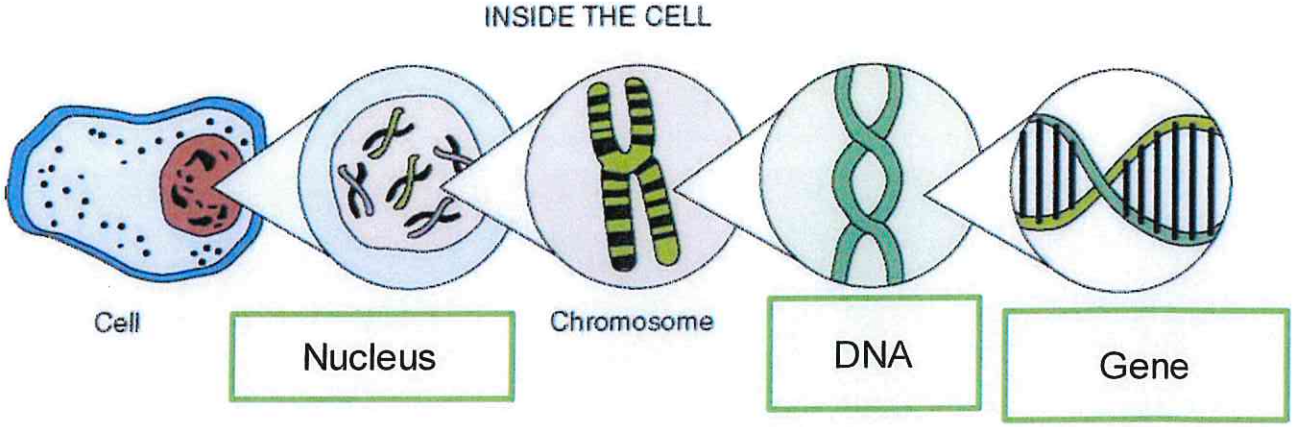
Lesson 1: SEXUAL AND ASEXUAL REPRODUCTION

1. Label the animal cell.



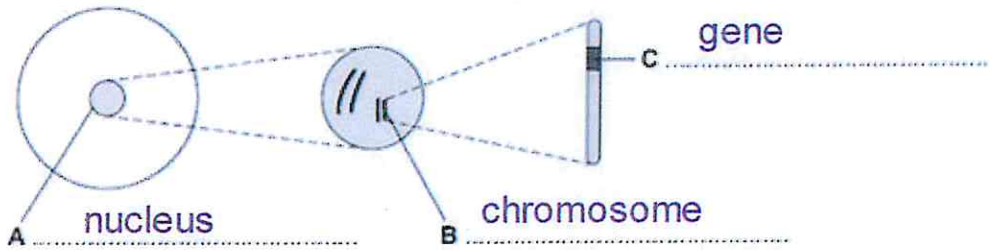
Nucleus,
cytoplasm,
cell membrane,
mitochondria

2. Label this diagram.



3. Diagram 1 shows an animal cell and some of the structures inside the cell.

Diagram 1



(a) Use words from the box to label structures A, B and C, on Diagram 1.

Characteristic	Chromosome	Gamete	Gene	Nucleus

(3)

4. Name the male gamete — Sperm

5. Name the female gamete — Egg

6. Where are the male gametes produced? — Testes

7. Where are the female gametes produced? — Ovaries

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Lesson 2: MEIOSIS

1. What are the 2 types of cell division?
Mitosis
Meiosis

2. Which type of cell division produces genetically identical cells?

Mitosis

3. What is **meiosis**?
Formation of gametes

4 Where does **meiosis** occur in the body?

Ovaries and testes

5. How many times does the cell divide in **meiosis**?

Twice

6. How many **chromosomes** do **gametes** have?

23

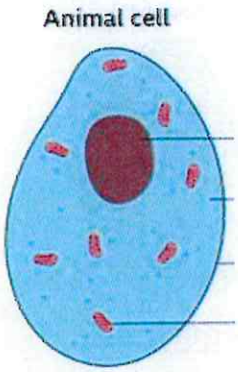
7. Why?

So when the nuclei fuse at fertilisation it creates 46 chromosomes

8. Describe what happens in **meiosis.**
Copies of the genetic information are made (DNA replicates)
The cell divides twice to form four **gametes**, each with a single set of **chromosomes** (23)
All **gametes** are genetically different from each other.

Lesson 3: DNA STRUCTURE

1. Label the diagram.



2. What structures are found within the **nucleus**?

CHROMOSOMES

3. What are these structures made of?

DNA

4. What is a **gene**?

SECTION OF DNA

5. What does a **gene** code for? (What is the function of a **gene**?)

CODES FOR A SEQUENCE OF AMINO ACIDS THAT CODE FOR A PARTICULAR PROTEIN

6. Describe the structure of **DNA**.

POLYMER
TWO STRANDS
DOUBLE HELIX

7. GENE, CHROMOSOME, AMINO ACID, PROTEIN

Lesson 5: Inheritance Rehearsal

Use your knowledge of 'Inheritance' key terms and the process of genetic crosses to decide whether the following are TRUE or FALSE (make sure you can explain why it is TRUE o r why it is FALSE):

1. 'bb' is an example of a homozygous genotype T
2. The word 'allele' means the same thing as the word 'gene' F
3. Chromosomes are made of DNA T
4. A somatic cell contains 46 pairs of chromosomes F
5. All living organisms contain gametes F
6. Genes are found within chromosomes T
7. 2 identical gametes are made in Mitosis F
8. Females have more chromosomes than males F
9. Each parent passes on 23 chromosomes to their child T
10. 'HH' is an example of a phenotype F

11. 'bb' x 'bb' will always produce 'bb' offspring T
12. Brown-eyed parents always have brown-eyed children F
13. There is a 50% chance of parents having a boy T
14. 'Hh' x 'HH' = 25% chance of 'HH' F
15. 'Ff' x 'Ff' = 50% chance of having a carrier T
16. Parents with polydactyly have children with polydactyly F
17. Parents with Cystic Fibrosis (CF) have children with CF T
18. 'BB' is described as Homozygous Dominant T
19. Recessive alleles are less likely to be passed on F
20. Phenotypes are determined by genotypes T

Lesson 6: SEX DETERMINATION

1. What is the genotype for males? XY

2. What is the genotype for females? XX

3. Complete the genetic cross diagram to show the determination of sex.

	X	X
X	XX	XX
Y	XY	XY

4.

Complete each sentence by choosing the correct terms from the box.

23	46	ADH	DNA	XX	XY	YY
dominant	female	male	recessive	strong	weak	

A gene is made up of a substance called ..... . Genes are found on chromosomes and most human cells contain ..... pairs of chromosomes. In females the two sex chromosomes are ....., but in males the two sex chromosomes are .....

Alleles are alternative forms of a gene. Two healthy parents can sometimes have a child with a genetic disorder such as cystic fibrosis. This is because cystic fibrosis is caused by a ..... allele. The two parents are healthy because they also have the ..... allele.

(Total 6 marks)

Lesson 7: VARIATION

1. What is **variation**?

Differences between individuals

2. Why do children generally look a little like their mother and their father, but are not identical to either?
They inherit their features from each parent's **DNA**.

3. Complete the table.

Inherited	Environmental
Eye colour	Tattoo
Hair colour	Scar
Blood group	Accent

4. State a characteristic that are influenced by both **environmental** and **inherited variation** and explain why.
Height
Tall parents will pass **genes** to their children for height.
Their children have the **genetic** potential to also be tall.
However, if their diet is poor then they will not grow very well: their environment also has an impact on their height.

5. What is a **mutation**?

A random and spontaneous change in the structure of a **gene**, **chromosome** or number of **chromosomes**

6. When can **mutations** occur?

Spontaneous, during cell division, through ionising radiation.

7. What affect do **mutations** normally have on the **phenotype**?

Almost no effect.

Lesson 8: NATURAL SELECTION

Examine the table and construct a graph. Plot the years of the study on the X-axis, and the number of moths captured on the Y axis. You should have 2 lines on your graph - one for light moths, and one for dark moths.

Year	Number of Light Moths Captured	Number of Dark Moths Captured
2	537	112
3	484	198
4	392	210
5	246	281
6	225	337
7	193	412
8	147	503
9	84	550
10	56	599

1. Explain in your own words what your graph shows

As the years passed, the number of light moths decreased and the number of dark moths increased. (KEY DESCRIPTION)
EXPLANATION...
This means that more light moths were getting eaten, most likely because they were easier to see by the birds. This could have been due to an environmental change, for example the industrial revolution. The soot from chimneys could have caused the tree bark to become darker, so the light moths stood out more, whereas the dark moth was more camouflaged. Over time the number of light moths decreased and the number of dark moths increased, because the dark moths were less likely to be eaten, so survived, reproduced and passed on genes to offspring.

2. What change in the environment could have occurred to cause the results shown in your graph?

Industrial revolution - more soot from chimneys depositing on trees, this made the tree bark darker so they dark moths were camouflaged and did not get eaten, whereas the light moths were easier to see and so did get eaten by birds.

3. What is a mutation?

Change in a gene.

Lesson 8b: NATURAL SELECTION

Use words from the box to complete the passage about natural selection.

evolution	environment	generation
mutate	survive	variation

Individual organisms of a species may show a wide range of variation because of differences in their genes.

Individuals with characteristics most suited to the environment are more likely to survive and breed successfully.

The genes that have helped these individuals to survive are then passed on to the next generation.

(4 marks)

The theory of evolution by natural selection was suggested in the 1800s.

Which scientist suggested this theory?

Darwin

(1 mark)

Charles Darwin proposed the theory of natural selection.

(a) What is meant by natural selection?

Survival of the fittest (1)
Those best adapted individuals to a given environment, survive (1), reproduce and pass on genes to offspring (1).

(2 marks)

Lesson 8cNATURAL SELECTION - ANSWERS

1. What is evolution?

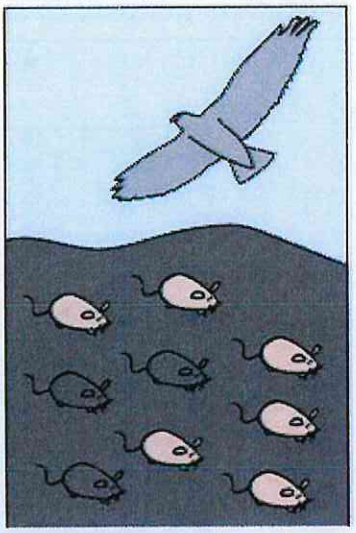
Theory that all species of all living organisms have evolved from simple life forms over millions of years.

Which scientist came up with the theory of evolution? Darwin

2. What is a mutation?

Change in a gene.

3. Look at the diagram below.



Which mice will survive and why?

The black mice as they are more camouflaged so less likely to get eaten.Why will the other mice not survive?

The white mice are easier for the birds to see, therefore more likely to get eaten.

What do the surviving mice then do? Reproduce and pass on genes to offspring.

_____

_____

4. What is natural selection sometimes referred to as?

Survival of the fittest

Lesson 9: SPECIATION

1. What is a **species**?

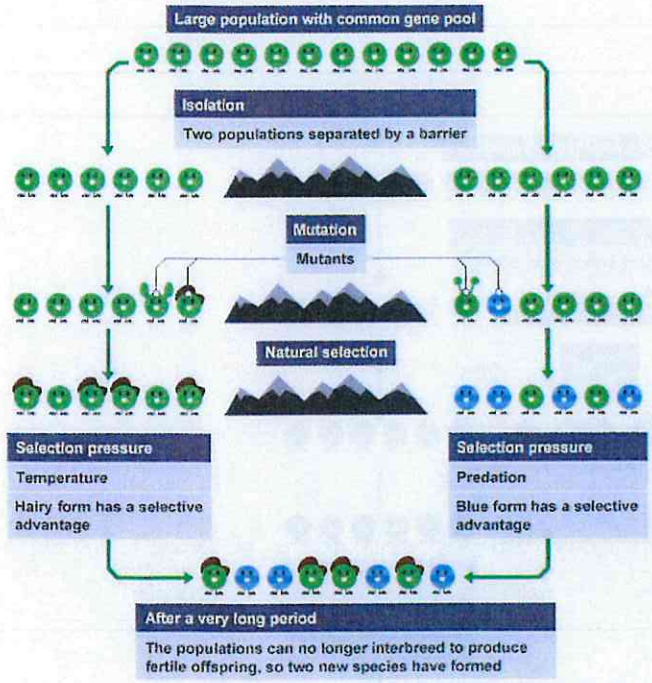
- A **species** is a group of organisms able to interbreed and produce fertile offspring.

2. What is **speciation**?

Speciation is the formation of two or more **species** from the original **species**.

3. Using the diagram below, describe the main stages in **speciation**.

- Two populations of a **species** can become geographically separated because of the environment.
- **Isolation** can prevent interbreeding and the combination of **genes** within a **species**.
- Different **mutations** can take place in the isolated groups and create different **phenotypes** within a particular location.
- Over time **species** may evolve to be different to each other, and they will not be able to interbreed.



Lesson 9b: SPECIATION

Lemurs are only found on the island of Madagascar.

Madagascar is off the coast of Africa.

Scientists think that ancestors of modern lemurs evolved in Africa and reached Madagascar about 50-60 million years ago.

Today there are many species of lemur living on Madagascar.

Figure 2 shows information about water currents.

Figure 3 shows the distribution of three species of lemur on Madagascar.

Figure 2

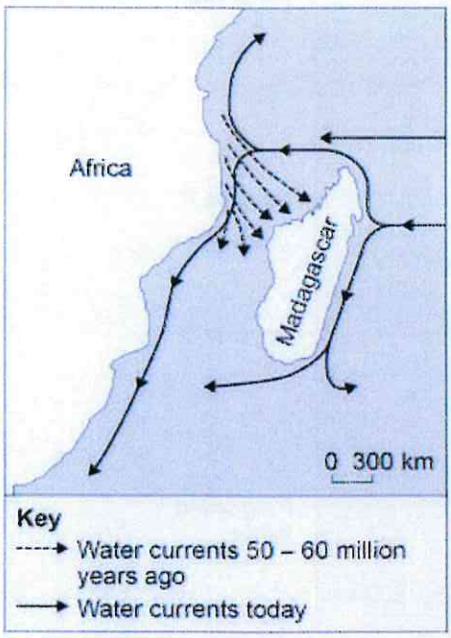
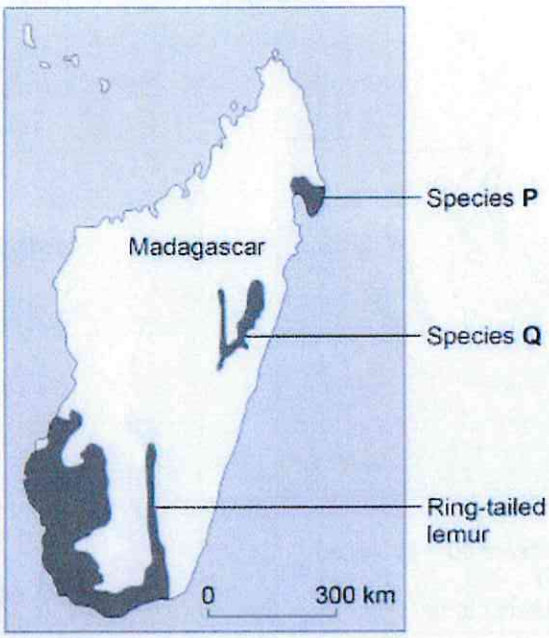


Figure 3



(c) Suggest how ancestors of modern lemurs reached Madagascar.

carried by (favourable) currents on masses of vegetation

Describe how the ancestors of modern lemurs may have evolved into the species shown in **Figure 3**.

- Two populations become **isolated**.
- There is **variation** in habitat between lemur populations.
- Genetic **variation** or **mutation** (in each population)
- Those better adapted survive (reproduce) **and** pass on (favourable) **alleles** to offspring.
- Eventually the separate populations cannot produce fertile offspring with other populations.

Lesson 9c: SPECIATION

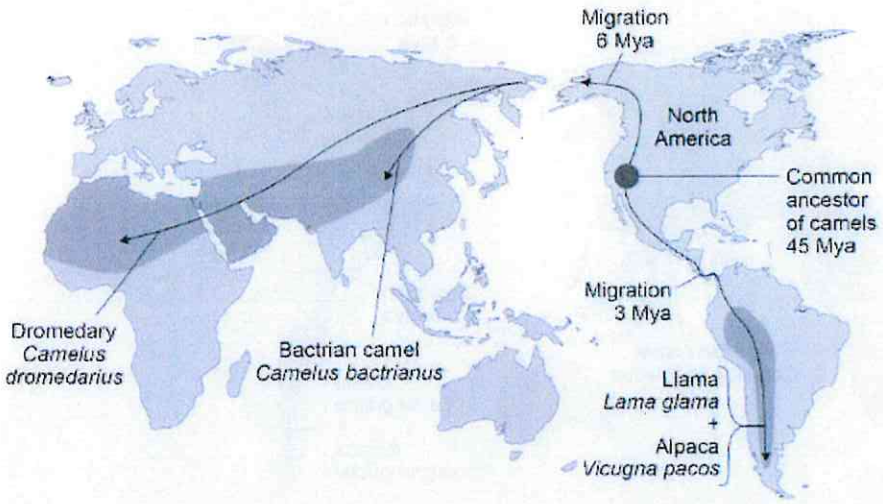
There are several species of the camel family alive today.

Scientists think these species evolved from a common ancestor that lived in North America about 45 million years ago (Mya).

Figure 2 shows:

- where four modern species of the camel family live today
- how the ancestors of these camels migrated from North America.

Figure 2



Explain how several different species of camel could have evolved from a common ancestor over 45 million years (6 marks)

- There is isolation of separate camel populations by sea/mountains
- There is habitat variation / described between populations

  allow examples – biotic (e.g. food / predators) or abiotic
- There is genetic variation / mutation in each population
- 45 million years is sufficient time to accumulate enough mutations
- Through natural selection, the better adapted survive to reproduce
- And pass on favourable allele(s) (genes)

Lesson 11: GENETIC ENGINEERING

1. What is genetic engineering?

Taking a gene from one organism and inserting into another organism.

2. What is the genome?

Entire genetic material in an organism.

3. What are the stages of genetic engineering?

1. Selection of the desired characteristic.
2. The gene responsible for the characteristic is 'cut out' of the chromosome using enzymes.
3. The gene is transferred and inserted into another organism.
4. At an early stage of development.

4.

Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

clones	chromosomes	embryos	genes

GM crops are produced by cutting _____ out of the _____ of one plant and inserting them into the cells of a crop plant.

(2)

Lesson 11b: GENETIC ENGINEERING

1. Complete the table of the benefits and risks of genetic engineering.

Benefits	Risks
Genetic modification is fast and efficient.	Transfer of the selected gene into other species. What benefits one plant may harm another.
Improve crop yields or quality, which may help reduce hunger around the world.	Some people believe it is not ethical to interfere with nature in this way.
Introduce herbicide resistance, which results in less herbicides being used, as weeds are quickly and selectively killed.	GM crops could be harmful to human health, for example toxins from the crops have been detected in some people's blood.
Insect and pest resistance can be developed and inserted into the plants. The plant produces toxins, which would discourage insects from eating the crop.	GM crops could cause allergic reactions in people.

(2)

2.

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields.
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for a GM crop can only be bought from one manufacturer.
- The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give **two** reasons why some farmers are in favour of growing GM crops.

1. _____

_____

2. _____

(2)

Give **two** reasons why many people are against the growing of GM crops.

1. _____

_____

2. _____

_____

Lesson 12: FOSSILS

1. What is a **fossil**?

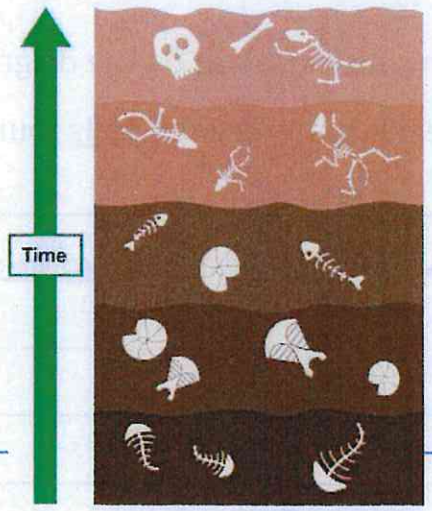
A **fossil** is the preserved remains of a dead **organism** from millions of years ago.

2. Describe the 3 main ways in which fossils are formed? Use the diagrams to help you.

From hard body parts, such as **bones** and shells, which do not **decay** easily or are replaced by **minerals** as they **decay.**

From parts of **organisms** that have not decayed because one or more of the conditions needed for **decay** are absent. For example, dead animals and plants can be preserved in amber, peat bogs, tar pits, or in ice.

From preserved traces of organisms, such as footprints, burrows and rootlet traces - these become covered by layers of **sediment**, which eventually become rock



3. In which location on the diagram are the most recent **fossils** found?

A

4. How can **fossils** provide **evidence** about **evolution**?

They show change over time.

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Lesson 12b: FOSSILS

Describe **three** ways fossils can be made.

_____

_____

_____

_____

_____

_____

Figure 2 shows what scientists think a living Plesiosaur may have looked like.

Figure 2

Scientists think that the Plesiosaur had smooth skin, with no scales.

The scientists **cannot** be certain what the skin of a Plesiosaur was like.
Suggest why.

_____

_____

How can fossils give evidence for evolution?

_____

_____

Scientists are uncertain about how life began on Earth.

Why?

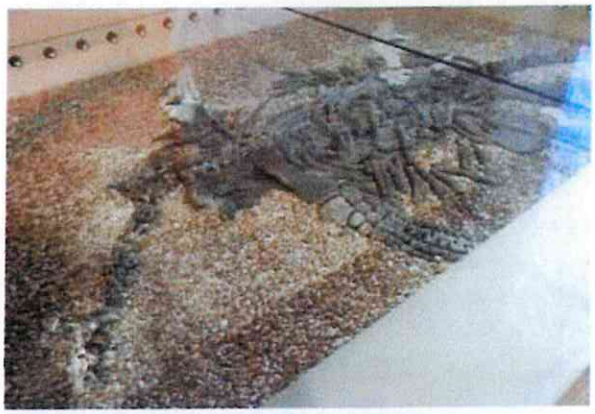
_____

_____

Lesson 12b: FOSSILS

Figure 1 shows a fossil of a sea animal called a Plesiosaur.
The Plesiosaur was alive about 135 million years ago.

Figure 1



(a) How can fossils give evidence for evolution?

Tick (✓) **one** box.

Newer fossils are simpler than older fossils. ☐

Fossils show change over time. ☒

All fossils show the bones of animals. ☐

The photograph shows a fossil footprint. The fossil was found in a rock at the bottom of a shallow river.

Scientists believe this is the footprint of a dinosaur. The dinosaur was alive 110 million years ago.

© Pearl Jackson/iStock

(a) (i) Suggest how the fossil shown in the photograph was formed.

Animal walking on soft material then it is buried and turns to rock.

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Lesson 12b: FOSSILS

Describe **three** ways fossils can be made.

Parts of **organisms** have not decayed.

- Conditions needed for **decay** are absent.
- Parts of the **organism** are replaced by **minerals** as they **decay.**
- Traces of organisms, eg footprints, burrows and rootlet traces.

Figure 2 shows what scientists think a living Plesiosaur may have looked like.

Figure 2

© Andreas Meyer/Hemera/Thinkstock

Scientists think that the Plesiosaur had smooth skin, with no scales.

The scientists **cannot** be certain what the skin of a Plesiosaur was like.
Suggest why.

They were soft bodied.

How can fossils give evidence for evolution?

Fossils can show how **organisms** have changed over time.

Scientists are uncertain about how life began on Earth.

Why?

Early life forms were soft bodied so insufficient evidence.

Lesson 13: EXTINCTION

Give **three** reasons, other than volcanic activity and collision with an asteroid, why a species may become extinct.

1. • New **predators**
2. • New **disease** / named pathogen
   • **Competition** for food
   • **Competition** for mates
3. • Lack of habitat or habitat change
   • Flooding
   • Drought

The dodo became extinct about 80 years after Dutch sailors first discovered the island in the eighteenth century.

Scientists are uncertain about the reasons for the dodo's extinction.

Suggest an explanation for this uncertainty.

• The **evidence** has gone (no records).

Lesson 14b: ANTIBIOTIC RESISTANT BACTERIA

MRSA strains of bacteria are causing problems in many hospitals.

(a) The diagram shows a hand-gel dispenser.

Hand-gel dispensers are now placed at the entrance of most hospital wards.

Explain why.

- kills / destroys bacteria / MRSA
- so prevents / reduces transfer

(2)

Explain, as fully as you can, how MRSA strains of bacteria became difficult to treat.

- Random **mutation** (1)
- So **bacteria** became **resistant** (1)
- To **antibiotics** (1)

(3)

Lesson 14b: ANTIBIOTIC RESISTANT BACTERIA

Bacteria can evolve rapidly.

Many bacteria can develop into new strains which are resistant to antibiotics.

Complete the table below to show if each action is **more likely** or **less likely** to help bacteria to become antibiotic resistant.

Put a tick in each row.

Action	More likely	Less likely
Take painkillers for headache		✖
Washing with antiseptic hand gel		✖
Adding antibiotics to food for cows	✖	
Giving antibiotics for colds and flu	✖	
Stopping antibiotics as soon as you feel better	✖	

Many strains of bacteria have developed resistance to antibiotics.

The table shows the number of people infected with a resistant strain of one species of bacterium in the UK.

Year	2004	2005	2006	2007	2008
Number of people infected with the resistant strain	3499	3553	3767	3809	4131

(a) Calculate the percentage increase in the number of people infected with the resistant strain between 2004 and 2008.

Show clearly how you work out your answer.

(4131 - 3499) ÷ 3499 × 100

Percentage increase = 18.06 / 18 / 18.1

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Lesson 15: CLASSIFICATION

1. Which scientist first came up with the traditional idea of classification?

Linnaeus

2. Name the 7 divisions of the traditional method of classitication in the correct order.

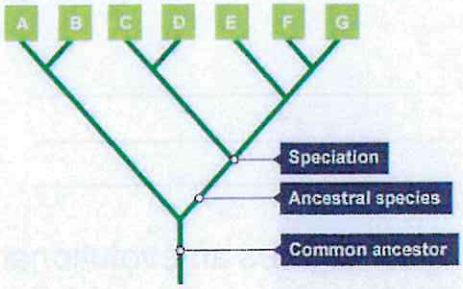
- **kingdom**
- **phylum**
- **class**
- **order**
- **family**
- **genus**
- **species**

3. Which two parts does the binomial system refer to?

genus and species

4. Which scientist developed the 3 domain system?

Woese



5. State the 3 main parts of this system.

Archea
Prokaryota
Eukaryota

6 What does an evolutionary tree show?

- They represent the relationships between a set of organisms.
- The tips of the tree often represent different species and where two branches join, this represents a common ancestor for those two species.

Lesson 15b: CLASSIFICATION

All living organisms are classified into groups.

Table 1 shows the classification of one species of wheat.

Table 1

Kingdom	Plant
Phylum	Angiosperms
Class	Monocotyledons
Order	Commelinids
Family	Poaceae
Genus	Triticum
Species	spelta

What is the binomial name for the wheat in **Table 1**?

Tick **one** box.

Angiosperm monocotyledons ☐

Poaceae triticum ☐

Species spelta ☐

Triticum spelta ☒

Modern classification systems compare the similarity between the DNA of organisms.

The more similar the DNA code, the more closely the organisms are related.

Table 2 shows DNA codes in five different organisms.

Table 2

	DNA Codes									Number of differences in DNA code compared with the human sequence
Human	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	
Pig	J	F	C	D	E	F	G	H	I	
Wheat	C	I	K	D	M	F	G	H	I	
Yeast	C	I	K	D	L	M	G	H	I	5
Chicken	J	F	C	D	M	F	G	H	I	3

(b) Complete the final column of **Table 2** for Pig and for Wheat.

(1)

Which organism in **Table 2** appears to be most closely related to humans?

pig

(1)

Give **one** reason why conclusions about the similarities between organisms should not be made using **only** the DNA codes in **Table 2**.

only a small sample (of DNA)

(1)

Lesson 21: Sustainable development

Define the key terms in the table

Key term	Definition
Finite	A finite resource is non-renewable. It is a resource that is not replenished as it is used.
Renewable	A renewable resource is one which is reformed at a similar rate to the one we use it at.
Sustainable	Resources that are used or harvested in such a way that it is not depleted or permanently damaged.
Natural	Resources that form without input from humans, come from air, earth or sea
Sustainable development	Development that meets the needs of the present, without compromising the needs of future generations.

What are natural resources used for?

- Fuels to provide warmth
- Building materials for shelter such as timber
- Food with the help of agriculture
- Fuels for transport
- Materials for clothing

Give an example where a natural resource has been replaced by a synthetic one.

- Wooden window frames replaced by plastic ones
- Natural rubber in tyres
- Cork in wine bottles.

Lesson 21: Sustainable development

Give an example of a finite resource and explain why it is a finite resource

Fossil fuels, metal ores. They are being used faster than they are being replaced so their supply is becoming limited._

Give an example of a renewable resource and explain why it is a renewable resource.

Timber, trees can be replanted and only take a few years to grow back.

Explain why it has become unsustainable to keep using finite resources.

The human population is growing at an increasing rate. Resources are needed to provide materials for building, food and energy for fuels and to provide warmth fr the growing human population.

The finite resources are being used at an increasing rate and are not being replaced fast enough.

This is way of life not sustainable

How can the use of finite resources be reduced?

- Use less
- Recycle
- Reuse an object
- Use a renewable alternative

What role do catalysts play in sustainable development?

Catalysts reduce the energy needed to carry out a reaction. This means less fossil fues are needed to be burnt reducing the demand on fossil fuels which a re a finite resource.

Lesson 22: Potable water

What is a potable water?

Water that is safe to drink.

What is the difference between potable water and pure water?

Pure water contains only water molecules whereas potable water is not pure because it contains other dissolved substances.

What are the requirements for potable water?

- Levels of dissolved salts are not too high
- It has a pH between 6.5 and 8.5
- There are no dangerous bacteria or other microorganisms in it.

What can potable water be produced from?

Fresh water and sea water_

What is fresh water and where is it found?

- **Fresh water** is water that does not have many dissolved substances in it.
- The water in lakes, reservoirs and groundwater are classed as **freshwater**.

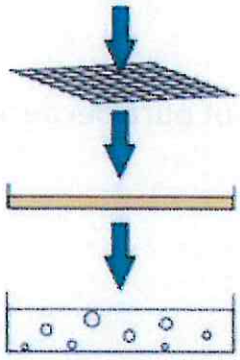
What is the preferred method to produce potable water and why?

The treatment of fresh water because it requires less energy compared to treating sea water.

Plesson 22: otable water

Use the diagram to answer the following questions

Name the stages in the production of potable water from fresh water.



Filttration

Sterilisation

Describe each step involved in producing potable water from fresh water and explain why it is used

Step 1 Description: A wire mesh is used to filter out any large objects and sand filter beds filter out smaller objects

Step 1 Explanation:

Filtration separates any insoluble solids from the water.

Step 2 Description: Sterilisation, chlorine, ozone or ultraviolet light are used._

Step 2 Explanation:

Sterilisation is used to kill harmful bacteria or other harmful microorganisms.

Plesson 22: otable water

For what reason would sea water be used to produce potable water?

In dry countries where there is limited fresh water.

What are the methods to produce potable water from sea water?

Distillation or reverse osmosis.

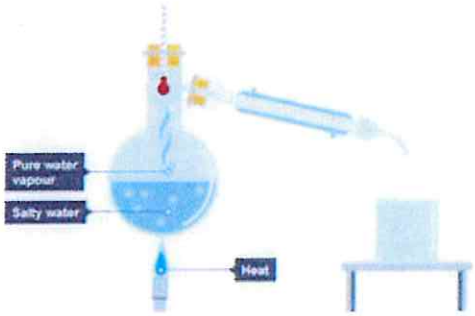
What is desalination?

Desalination is the removal of salt from a salt solution.

What are these not the preferred methods to produce potable water?

They require a lot of energy.

Use the diagram to describe the steps involved in distillation?



- The salty water is heated to beyond the boiling point of water.
- The water evaporates and turns into a gas.
- The gas enters the condenser and cools and condenses.
- Pure water is collected.

Lesson 23: Waste water treatment

What does industrial waste water contain?

- Organic matter
- Harmful chemicals

What does sewage water from homes and agricultural waste water contain??

- Organic matter
- Harmful microorganisms

Name stage one in the treatment of sewage water.

Screening

Explain what happens in stage one.

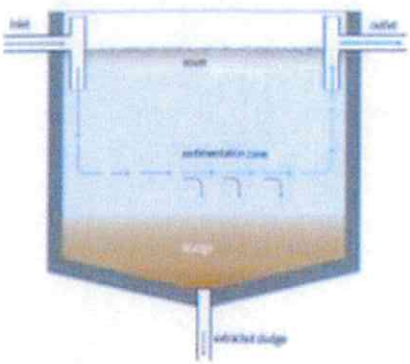
- **Screening** involves the removal of large pieces of material such as twigs and plastic as well as any grit.

Name stage two in the treatment of sewage water?

Sedimentation

Use the diagram to explain what happens during stage two of the process.

Sedimentation happens in a settlement tank. The screened waste water is left to stand in a settlement tank The heavier solids in the sewage water sink to the bottom of the tank to produce sludge. The less dense liquid floats to the top, this is known as effluent.



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Lesson 23: Waste water treatment

What is the effluent and where is it found and where does it go after treatment?

The less dense liquid in the settlement tank floats to the top, this is known as effluent.

After treatment it is released into the environment

What is the sludge and where is it found?

The heavier solids in the sewage water sink to the bottom of the tank to produce sludge._

Explain how the effluent is treated?

- The effluent is removed from the top of the tank and is treated by biological aerobic digestion. During aerobic digestion aerobic digestion air is pumped through the water. The air encourages aerobic bacteria to break down any organic matter including other microorganisms in the water and the water is safe to be released into the environment.

Explain how the sludge is treated?

- The sludge is removed from the tank and gets broken down by bacteria which carry out anaerobic digestion. Organic matter is broken down to release methane gas which is used as an energy source.

What happens to the effluent and sludge once they have been treated?

- The digested waste that is remaining can be used as a fertiliser.

Lesson 24: Life cycle assessment

What does a life cycle assessment do?

- A life cycle assessment assesses the environmental impact of products in each stage of its life.

Complete the table below with the stages of the life cycle assessment and the factors that need to be considered at each stage .

Life cycle assessment stage	Factors that need to be considered during this stage.
Extracting and processing raw materials	The damage caused to the local environment during extraction Energy resources needed to extract causing pollution Energy resources needed to transport raw materials causing greenhouse gas emissions and global warming The waste produced when processing raw materials
Manufacturing and packaging	Chemical reactions used to make products from the raw materials can produce waste products. The machinery involved in making the products needs energy and can cause pollution.
Using the product	Does using the product involve burning fossil fuels? Does using the product cause chemicals to be leaked into the environment? How long does the product last during its useful life?
Disposal of the product	The energy used to transport the waste to the landfill emits greenhouse gases. Landfill can pollute land and water. Non-biodegradable can take up space in a landfill for longer Incinerating waste causes air pollution Can part or all or the product be recycled or reused

Lesson 24:

A life cycle assessment is not completely objective. What do we mean by this statement?

It is not always easy to give accurate numerical values for parts of a LCA. Some parts of a LCA require judgements, such as the effect of pollutants. This means that completing a LCA is not a totally objective process, and different people might come up with different judgements.

It is important to consider who has completed the LCA and whether they have any **bias**. For example, if the LCA is completed by the company which is making and selling a product, they might only include some parts of the genuine environmental impact

Lesson 24: Life cycle assessment

The picture represents a life cycle assessment for a mobile phone. Complete each box to explain the environmental impact of each stage of the life cycle.

Raw materials – plastic and metal

Plastic is made from crude oil which is a finite resource. Energy is needed for the extraction process.

Metal ores are also a finite resource. Energy is needed for mining rocks, transporting large rocks and moving any waste produced. Burning fossil fuels to release energy also release CO_2 which is a greenhouse gas.

Manufacturing and packaging

Energy is needed for fractional distillation to heat up the crude oil to evaporate it as well as cracking.

The manufacturing process requires machinery to produce the finished product. This also requires energy. The product is packaged and transported to warehouses and shops. Both also requiring energy resources.

Using the product

Mobile phones contain a battery which needs charging throughout its life. This uses electricity which involves the burning of fossil fuels and releasing CO_2. Mobile phones can be reused and can also be recycled.

Product disposal

Mobile phones can be recycled for their parts. They are not biodegradable.

Lesson 24: Life cycle assessment

Below is a life cycle assessment comparing a plastic bag with a paper bag.

Life cycle assessment stage	Plastic bag	Paper bag
Raw material	Crude oil	Timber
Manufacturing and packaging	Fractional distillation of crude oil. Cracking of long chains Polymerisation reaction Other products also have uses.	Timber is pulped which requires energy. Lots of waste made which needs disposal.
Using the product	Can be reused.	Usually used once.
Product disposal	Can be recycled. Not biodegradable	Can be recycled. Not biodegradable.

Student A claims we should use paper bags because they come from trees and are biodegradable. Student B claims we should use plastic bags because they can be reused. Which student is correct? Explain your choice by evaluating by the life cycle assessments.

The crude oil is a finite resource and is becoming limited and fractional distillation, cracking and polymerisation all require a large amount of energy which involves the further use of fossil fuels. Burning fossil fuels to release energy also releases carbon dioxide which is a greenhouse gas and contributes to global warming. Paper bags can be made from recycled paper, or from trees. Trees can be replanted which means this is a renewable resource. Making paper from trees requires more energy than recycling paper, but much less than making plastics. Plastic bags have a longer useful life than paper bags. They can also be used for other purposes such as bin liners. At the end of their useful life plastic bags can be recycled. Paper bags can usually on be used once but then can be recycled and are biodegradable which is better for the environment.

In conclusion, the life cycle assessment assessment shows that student A is correct because paper bags are made from a renewable resource rather than a finite one and require less energy to process and manufacture. Although plastic bags can be reused and recycled, paper bags are biodegradable and so will not take up space in a landfill for as long as a plastic bag.

Lesson 25: Ways of reducing the use of resources

Why do we need to reduce the use of the Earth's resources?

Finite resources are limited. They will eventually run out if we do not find ways of reducing their use.

Metals, glass, building materials and most plastics come from finite resources so it is important that we find ways to reduce the use of these resources.

How do we reduce the use of Earth's limited resources?

Recycle or reuse.

What is the difference between recycling and reusing?

Recycling involves processing the waste material to make an entirely new product.

Reusing is using the product again for the same purpose or a different one with minimal modifications.

Why are metals recycled?

Metals come from metal ores which are a finite resource. The supply of metal ores is limited and so the use of these needs to be reduced.

How are metals recycled?

The metals are separated and sorted depending on the properties required. They are melted and then recast into different products._

Lesson 25: Ways of reducing the use of resources

What are the advantages and disadvantages of recycling metals?

for recycling

- metal **ores are conserved**
- less energy needed for extracting the metal **ore**
- less mining / quarrying
- less waste and less going to landfill

against recycling

- collection problems
- transport problems
- difficult to separate the metal from appliances
- energy used to melt the metal

How do we reduce the amount or iron needed to be extracted from iron ore?

scrap steel can be added to iron from a blast furnace to reduce the amount of iron that needs to be extracted from iron ore.

How is glass recycled?

- Separating it by colour.
- Crushing the glass
- Melting and then reshaped to make a new glass product.

Lesson 26: Longitudinal and Transverse Waves

1) What is a transverse wave?

A wave where the oscillations are perpendicular to the direction of wave travel.

2) Name 2 examples of transverse waves.

Light, x-rays, ripples on the surface of water, vibration of waves on a guitar string.

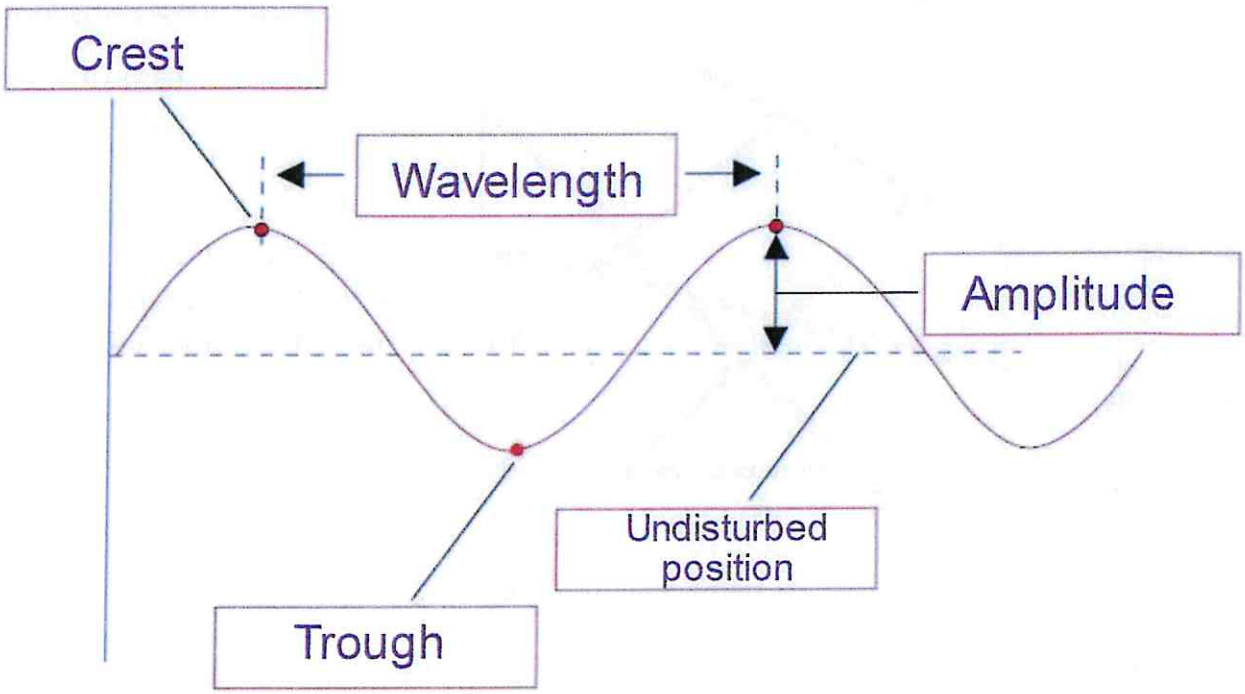
3) What is a longitudinal wave?

A wave where the oscillations are parallel to the direction of wave travel.

4) Name 2 examples of longitudinal waves.

Sound, ultrasound

5) Label the Transverse wave below:



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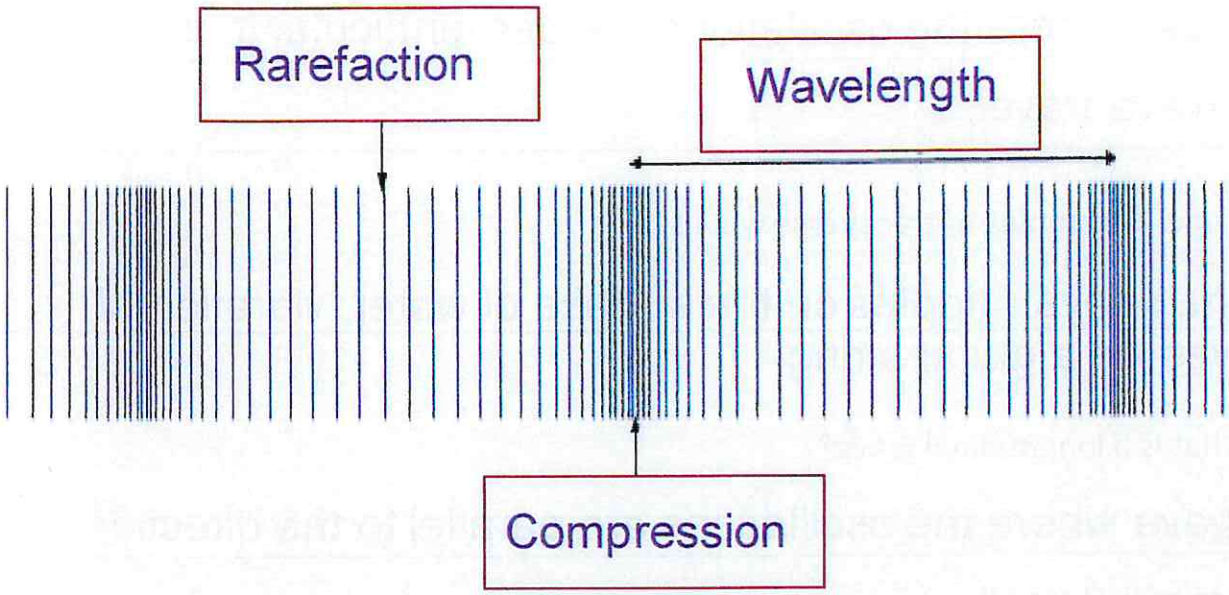
Lesson 26: Longitudinal and Transverse Waves

6) Label the Longitudinal wave below:



7) Match the following words with their correct definitions.

Word	Definition
Crest	The maximum displacement of a point on a wave away from its undisturbed position.
Trough	Regions of low pressure due to particles being spread further apart.
Amplitude	distance from a point on one wave to the equivalent point on the adjacent wave.
Wavelength	The highest point in a wave.
Compression	Regions of high pressure due to particles being close together.
Rarefaction	The lowest point in wave.

Lesson 26: Longitudinal and Transverse Waves

8) Describe the difference between longitudinal and transverse waves. (3 marks)

The oscillation / vibration (causing the wave)

a movement causes the wave is insufficient

1

For a transverse wave is perpendicular to the direction of energy transfer

accept direction of wave travel

1

and for a longitudinal wave is parallel to the direction of energy transfer

accept direction of wave travel

*if no marks awarded allow **1** mark for correctly linking perpendicular with transverse and parallel with longitudinal*

1

9) What evidence confirms that waves transfers energy and not matter? (4 marks)

Ripples across a waters surface

1

If a ball is placed on the surface of a pond when ripples move across it, the ball will move up and down but not outwards with the wave.

1

Sound travelling through air

1

Sound waves move through the air to a person's ear, the air itself does not move - instead the sound is transferred through the vibrating molecules, which stay where they are and vibrate about a fixed point. This can be seen in a speaker that vibrates particles near the surface backwards and forwards.

1

Lesson 27: Properties of Waves

1) Define frequency.

The frequency of a wave is the number of waves passing a point each second.

2) Define time period.

Time period is how long it takes for one full wave to be completed.

3) What is the frequency of a paddle that vibrates 10 times in 10 seconds?

Frequency is how many per second → 10 in 10 seconds means 1 per second. → 1 Hz

4) Calculate the frequencies of the following waves:

a) A wave with a time period of 2 seconds.

$f = 1 \div T = 1 \div 2 = 0.5$ Hz

b) A wave with a time period of 0.004 seconds.

$f = 1 \div T = 1 \div 0.004 = 250$ Hz

c) A wave with a time period of 0.5 hours.

0.5 hours = 30 minutes. 30 minutes x 60 = 1800 seconds

$f = 1 \div T = 1 \div 1800 = 0.00056$ Hz

5) Calculate the time periods of the following waves:

a) A wave with a frequency of 15 Hz.

$T = 1 \div f = 1 \div 15 = 0.067$ Seconds

b) A wave with a frequency of 2 KHz.

$T = 1 \div f = 1 \div 2 = 0.5$ Seconds

c) A wave with a frequency of 0.1 Mhz.

$T = 1 \div f = 1 \div (0.1 \times 1000000) = 1 \times 10^{-5}$ Seconds

Lesson 27: Properties of Waves

6) What is the equation that links wave speed, frequency and wavelength?

Wave speed = frequency x wavelength

---

7) Calculate the **wave speed** (in m/s) for the following waves:

a) A sound wave in steel with a frequency of 500 Hz and a wavelength of 3.0 metres.

$v = f \times \lambda = 500 \times 3.0 =$ 1500 m/s

b) a ripple on a pond with a frequency of 2 Hz and a wavelength of 0.4 metres.

$v = f \times \lambda = 2 \times 0.4 =$ 0.8 m/s

c) A radio wave with a wavelength of 30 m and a frequency of 10,000,000 hertz.

$v = f \times \lambda = 10000000 \times 30 =$ 300000000 m/s

8) Calculate the **wavelength** (in metres) for the following waves:

a) A wave on a slinky spring with a frequency of 2 Hz travelling at 3 m/s.

$\lambda = v \div f = 3 \div 2 =$ 1.5 m

b) An ultrasound wave with a frequency 40,000 Hz travelling at 1450 m/s in fatty tissue.

$\lambda = v \div f = 1450 \div 40000 =$ 0.036 m

c) A sound wave with frequency 440 Hz travelling at 340 metres per second in air.

$\lambda = v \div f = 340 \div 440 =$ 0.773 m

Lesson 27: Properties of Waves

9) Calculate the **frequency** (in Hz) for the following waves:

a) A sound wave of wavelength 10 metres travelling at 340 metres per second in air.

$$f = v \div \lambda = 340 \div 10 = \underline{34\ Hz}$$

b) A wave on the sea with a speed of 8 m/s and a wavelength of 20 metres.

$$f = v \div \lambda = 8 \div 20 = \underline{0.4\ Hz}$$

c) A microwave of wavelength 0.15 metres travelling through space at 300,000,000 m/s.

$$f = v \div \lambda = 300000000 \div 0.15 = \underline{2000000000\ Hz}$$

Lesson 27: Properties of Waves

Exam Questions.

1. A note was played on an electric keyboard. The frequency of the note was 440 Hz

(a) (i) What does a frequency of 440 Hz mean?

440 (sound) waves produced in one second

accept vibrations / oscillations for waves

(1)

(ii) The sound waves produced by the keyboard travel at a speed of 340 m / s.
Calculate the wavelength of the note.

Give your answer to **three** significant figures.

$\lambda = v \div f$

$= 340 \div 440$

$= 0.77\dot{2}$ (this means 0.772727272727272...)

This rounds to 0.773 to 3.s.f.

Wavelength = 0.773 metres

(3)

2. A lorry has an air horn. The air horn produces sound waves in the air.

(a) Use **one** word to complete the following sentence.

Sound waves cause air particles to Vibrate .

(1)

(b) The air horn produces sound waves at a constant frequency of 420 Hz.
The wavelength of the sound waves is 0.80 m.

Calculate the speed of the sound waves.

$v = f \times \lambda$

$= 420 \times 0.80$

$= 336$

Speed = 336 m/s **(2)**

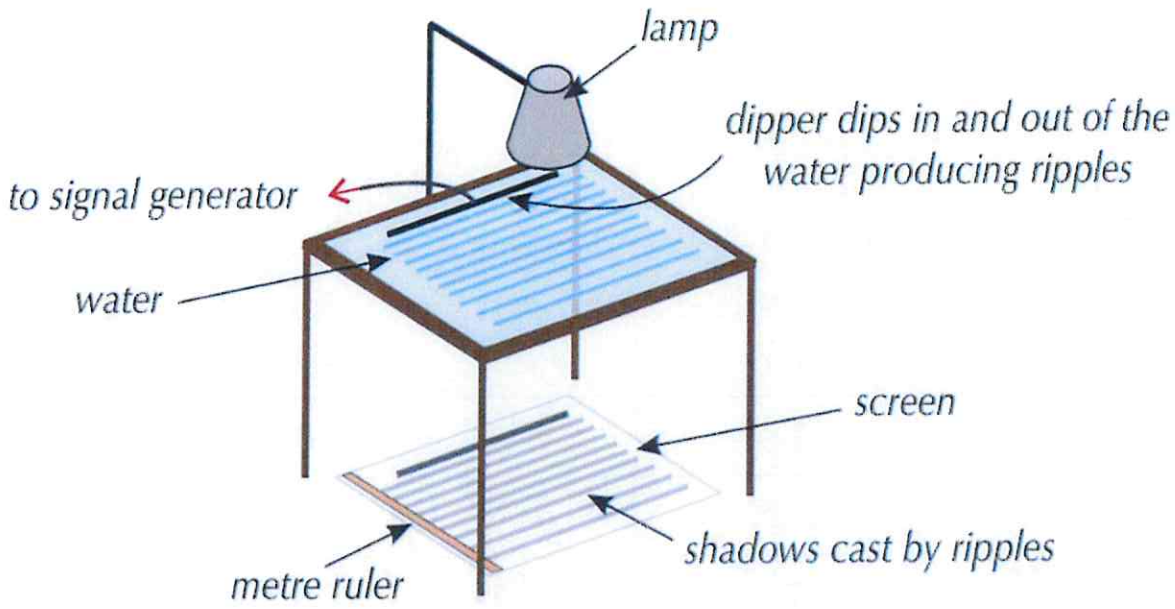
Lesson 28: Ripples on the surface of water – Required practical

Hypothesis:

As frequency increases the speed of the wave stays the same.

Method:

Figure 1:



1. Set up the ripple tank shown in figure 1. (diagram on previous page)
2. Count the number of waves that pass a given point every 10 seconds. Record your results.
3. Divide by 10 to get the numbers of waves per second. This is the frequency.
4. Measure the length of 10 waves. Record your results.
5. Divide by 10 to get length of one wave. This is the wavelength.
6. Change the frequency and take the measurements again .
7. Repeat this until you have at least six sets of results.
8. Calculate the wave speed using the equation: wave speed = frequency x wavelength.

Lesson 28: Ripples on the surface of water – Required practical

My result from ripple tank video

Result	Number of waves in 10 seconds	Wave Frequency (Hz) – number of waves in 1 second	Length of 10 waves (m)	Wavelength (m) – length of 1 wave	Speed (m/s)
From video	get in lesson	get in lesson	get in lesson	get in lesson	get in lesson

Exemplar Results

Result	Number of waves in 10 seconds	Wave Frequency (Hz) – number of waves in 1 second	Length of 10 waves (m)	Wavelength (m) – length of 1 wave	Speed (m/s)
1	115	11.5	0.385	0.0385	0.44
2	135	13.5	0.335	0.0335	0.45
3	155	15.5	0.300	0.0300	0.47
4	173	17.3	0.240	0.0240	0.42
5	191	19.1	0.210	0.0210	0.40
6	211	21.1	0.190	0.0190	0.40

Conclusion

As frequency increases the speed of the wave stays the same.

Lesson 28: Ripples on the surface of water – Required practical

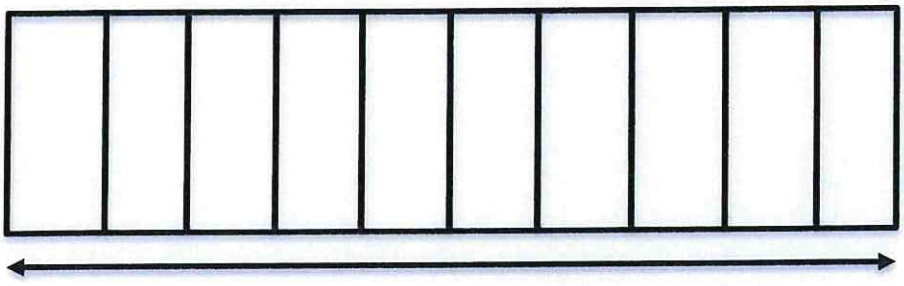
Post practical questions.

1. Describe an experiment to find the speed of a wave through water.

- Set up the ripple tank shown in figure 1. (diagram on previous page)
- Count the number of waves that pass a given point every 10 seconds. Record your results.
- Divide by 10 to get the numbers of waves per second. This is the frequency.
- Measure the length of 10 waves. Record your results.
- Divide by 10 to get length of one wave. This is the wavelength.
- Change the frequency and take the measurements again .
- Repeat this until you have at least six sets of results.
- Calculate the wave speed using the equation: wave speed = frequency x wavelength

2. What are the units for frequency? Hertz (Hz)

Look at the following ripple tank.



3. Use the diagram to find the approximate wavelength.

Total length / number of waves
1.2 m / 10 = 0.12 m

4. Calculate the frequency of the waves.

Frequency = number of waves/ time
10/ 10 = 1 Hz

5. Use this information to find the wave speed

Wave speed = frequency x wave length
1 x 0.12 = 0.12 m/s

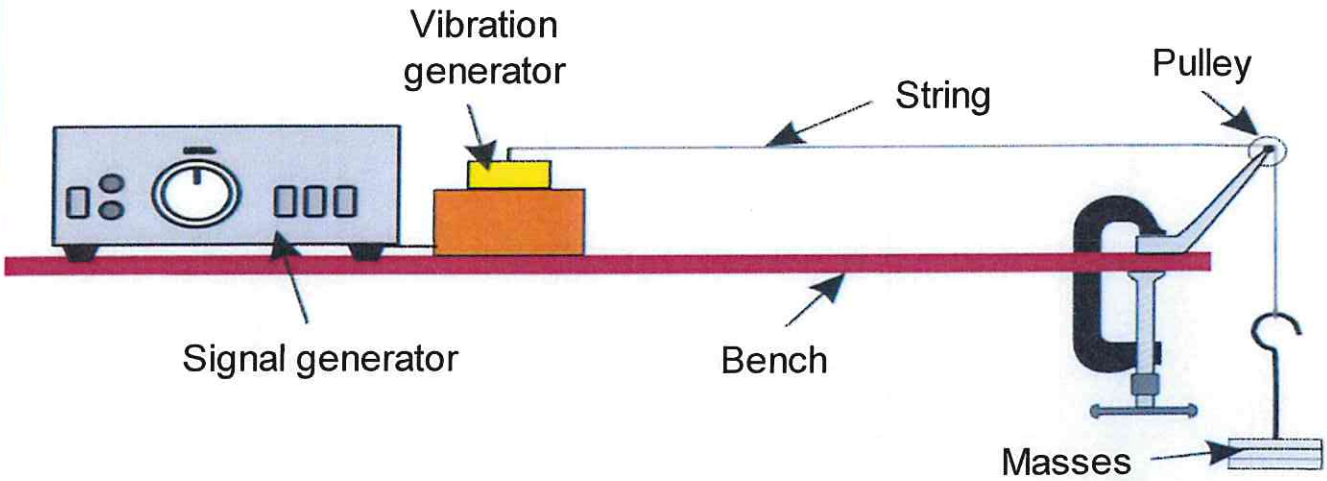
Lesson 28b: Required practical – Waves through a solid

Hypothesis:

As frequency increases the speed of the wave stays the same.

Method:

Figure 1:



1. Set up the equipment as shown in figure 1.
2. Turn on the signal generator and the attached string will start to vibrate up and down.
3. Move the wooden bridge until it looks like the waves are no longer moving and you see a standing wave.
4. Record the length of as many half wavelengths are on your string.
5. Divide the total length of those wavelengths by the number of half wavelengths, and then double this. You will now have the wavelength of one full wave.
6. Record the frequency of the signal generator.
7. Calculate the wave speed using the equation: wave speed = frequency x wavelength.
8. Change the frequency on the signal generator and repeat steps 2 – 6 twice more.

Results table - Different from each time this practical is done

Wave Frequency (Hz)	Total wave distance (m)	Number of half wavelengths (m)	Distance of one half wavelength (m)	Wavelength (m)	Speed (m/s)

Conclusion

As frequency increases the speed of the wave stays the same.

Lesson 28b: Ripples on the surface of water – Required practical

1) Calculate your mean speed of the wave through the string.

Dependent on practical. Add all three speeds together and divide by three.

2) What is the range in your speeds?

Dependent on practical. Biggest takeaway the smallest.

3) Why do we need to count over many half wavelengths, rather than measuring the length of a signal wavelength?

This reduces error in the investigation.

4) Complete the risk assessment below for this experiment

Hazard	Risk	Control
Vibrating generator.	Catching you finger on moving parts, could cause injury.	Keep your hand away when it is turned on
Masses	Falling off he pulley and hitting you foot.	Stand away from the masses when the are attached to the pulley. Take off as soon as the experiment is finished

Lesson 28c: Sound waves through air

1) What are the 3 ways we can measure the speed of sound in air?

1. You use an event that has a visible indication that an event has happened and that produces a sound at the same time. You also need to be a know distance away from the event happening. You can then time using a stopwatch the time from when you see the event to when you hear it. You can then use speed = distance / time to get the speed of sound.

2. You can use an echo. You start a stopwatch from when a sound is produced and stop the stopwatch when you hear the echo. You then need to know how far the sound has travels. This will be twice the distance between the object making the sound and the object reflecting the sound. You can then use speed = distance / time to get the speed of sound.

3. You can use 2 microphones and a digital timer. You need to know the distance between the two microphones. When a sound is made the timer will record how long it takes for the sound to get from microphone A to microphone B. You can then use speed = distance / time to get the speed of sound.

Lesson 28c: Sound waves through air

All calculations must show full working out for the marks.

4) A lightning bolt hits the ground 4 km away from where you are. It takes 12 seconds for the sound to of the fire work to reach you. What is the speed of sound?

$$Speed = \frac{Distance}{time} = \frac{4000}{12} = 333.3\ m/s$$

3) A race is started when a person shoots a pistol into the air. You are stood at the finish line 1km away. You see the man fire the pistol into the air but don't hear the pistol until 3 seconds into the race. How fast is the speed of sound?

$$Speed = \frac{Distance}{time} = \frac{1000}{3} = 333.3\ m/s$$

4) A person claps 350 m away from of a mountain. He hears an echo 2.1 second later. What is the speed of sound?

$$Speed = \frac{Distance}{time} = \frac{2\ x\ 350}{2.1} = \frac{700}{2.1} = 333.3\ m/s$$

5) A women hits a drum. At the same time a stopwatch is started. An echo of the sound is heard 0.5 a second later. What is the speed of sound if the echo reflected off a wall 80 m away?

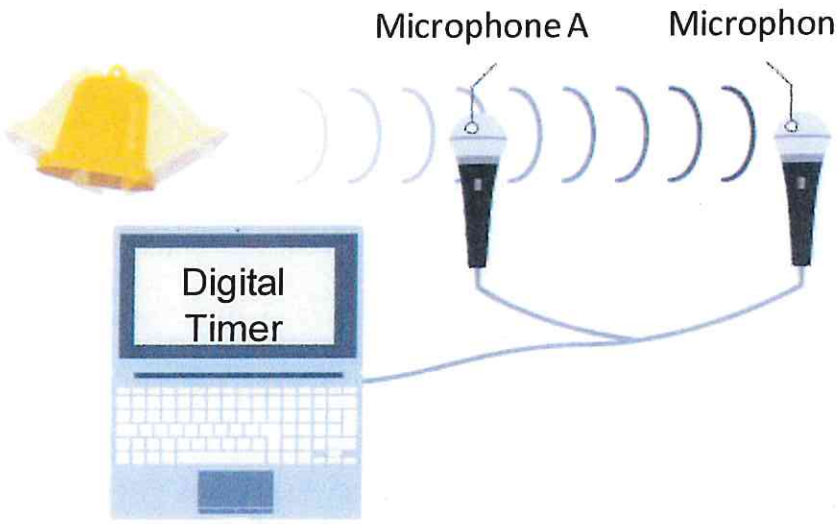
$$Speed = \frac{Distance}{time} = \frac{2\ x\ 80}{0.5} = \frac{160}{0.5} = 320\ m/s$$

6) Why do you think that the answer to number 5 isn't as close to the speed of sound (340 m/s) as some of the other answers?

Because it happens very quickly. A person does not have fast enough react times to accurately start and stop the timer.

Slesson 28c: ound waves through air

7) Two microphones are connected to a digital timer. When a bell is rand the timer will record how long it takes for the sound to get from microphone A to microphone B.



a) If microphone B is 2.00 metre further away from the source of sound than microphone A, and the clock records a time of 6.0 milliseconds. What is the speed of the sound wave.

$$Speed = \frac{Distance}{time} = \frac{2}{0.006} = 333.3\ m/s$$

b) If microphone B is 0.5 metre further away from the source of sound than microphone A, and the clock records a time of 1.5 milliseconds. What is the speed of the sound wave.

$$Speed = \frac{Distance}{time} = \frac{0.5}{0.0015} = 333.3\ m/s$$

c) If microphone B is 10 cm further away from the source of sound than microphone A, and the clock records a time of 0.3 milliseconds. What is the speed of the sound wave.

$$Speed = \frac{Distance}{time} = \frac{0.1}{0.0003} = 333.3\ m/s$$

8) Why might the method used in question 7 be a better method to use that the other methods used.

It will reduce error as there is not error from human reaction times with a stopwatch. It also can be used over much smaller distances.

Lesson 29: Type of Electromagnetic Waves

1) Complete the diagram below of the electromagnetic spectrum, below:

Radio	microwaves	Infrared	Visible Light	Ultra-violet	X-ray	Gamma

2) Which Electromagnetic wave has:

a) The lowest energy Radio

b) The highest energy Gamma

c) The longest wavelength Radio

d) The shortest wavelength Gamma

e) The lowest frequency Radio

f) The highest frequency Gamma

3) What is the speed of all waves in the electromagnetic spectrum?

The speed of slight, 300,000,000 m/s

4) What do all types of electromagnetic wave transfer from one place to another?

Energy

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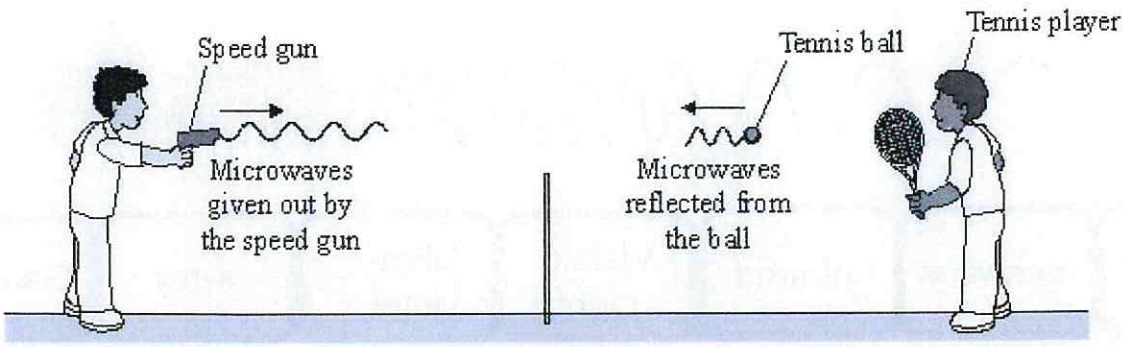
Lesson 29: Type of Electromagnetic Waves

5) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



a) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Calculate the wavelength of the microwaves emitted from the speed gun. Show clearly how you work out your answer.

$$\lambda = \frac{v}{f} = \frac{300{,}000{,}000}{24{,}000{,}000{,}000} = 0.0125\ m$$

Wavelength = $0.0125\ m$ m

b) Some of the microwaves transmitted by the speed gun are absorbed by the ball. What effect will the absorbed microwaves have on the ball?

Increase the temperature of the ball.

Lesson 29: Type of Electromagnetic Waves

6) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Here you know that ABC are all have
A longer wavelength than light.
So they are either radio, microwave
or infrared.
The longest wavelength must be radio = A
The 2nd longest wavelength must be microwave = B
The 3rd longest wavelength my be infrared = C

Which of the waves, **A**, **B** or **C**, is an infra red wave? C

7) Radio waves, ultra-violet, visible light and X-rays are all types of electromagnetic radiation.

(a) Choose wavelengths from the list below to complete the table.

3×10^{-8} m **1×10^{-11} m** **5×10^{-7} m** **1500 m**

TYPE OF RADIATION	WAVELENGTH (m)
Radio waves	1500 m
Ultra-violet	3×10^{-8} m
Visible light	5×10^{-7} m
X-rays	1×10^{-11}m

R m I V → longest so must be **1500 m**

V → next available so next lonest. **5×10^{-7} m**

U X → next available **3×10^{-8} m**

G → smallest wavelength in list so must be **1×10^{-11}m**

8) Microwaves are another type of electromagnetic radiation. Calculate the frequency of microwaves of wavelength 3 cm. (The velocity of electromagnetic waves is 3×10^8 m/s.)

$1\ cm = 0.01m \rightarrow 3cm = 0.03m$

$f = \frac{v}{\lambda} = \frac{3 \times 108}{0.03} = 1 \times 1010$

Frequency = 1×1010 m

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Lesson 2a: COMPARING MITOSIS AND MEIOSIS

1. Complete the comparison table

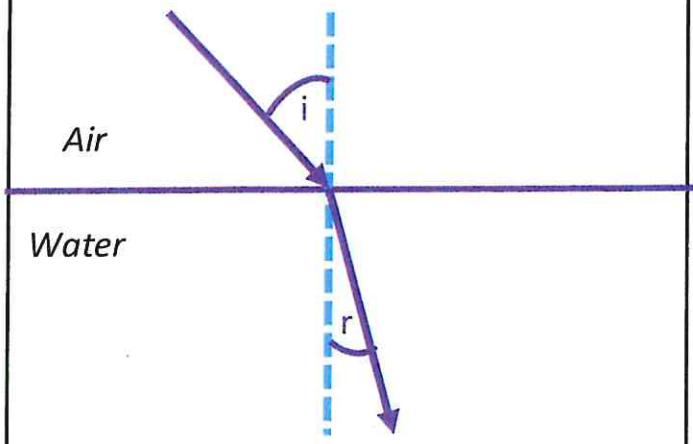
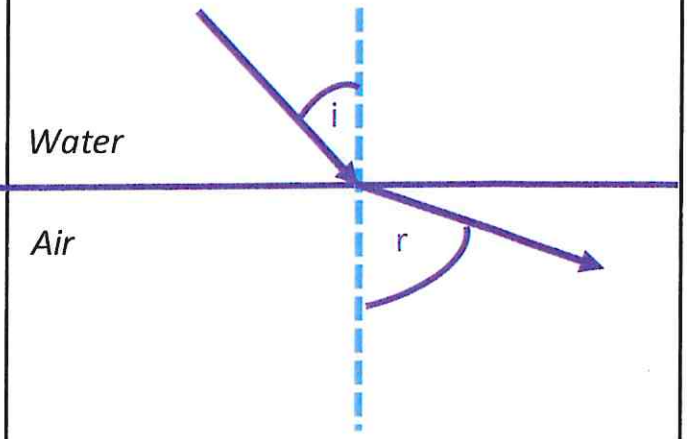
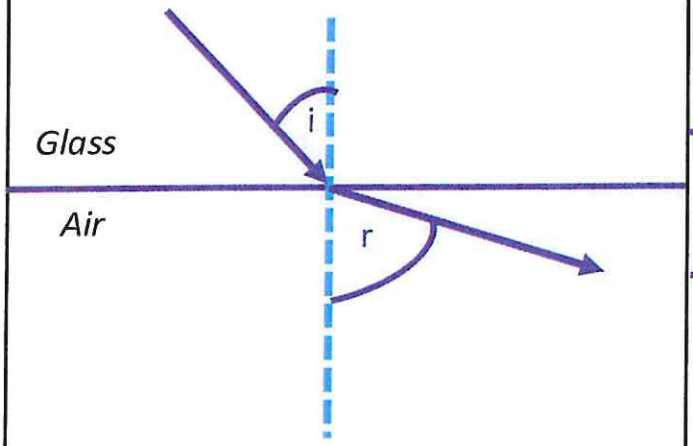
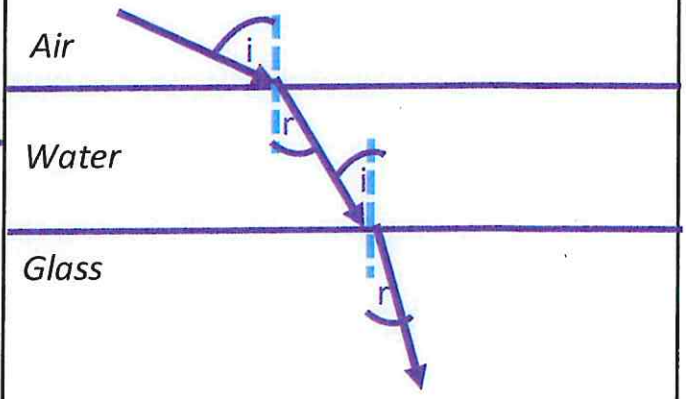
	Mitosis	Meiosis
Role	Cell division of normal body cells (growth and repair)	Formation of gametes
Number of divisions	1	2
Genetically identical?	Yes	No – variation
Number of daughter cells?	2	4
Asexual or sexual?	Asexual	Sexual
Number of chromosomes in daughter cells	46	23

2. Using your table to help, compare the two processes of **mitosis** and **meiosis**.

- **Mitosis** is **asexual reproduction**, whereas **meiosis** is **sexual reproduction**.
- In **mitosis** the cell divides once and produces 2 daughter cells, however in **meiosis** the cell divides twice and produces 4 daughter cells.
- In **mitosis** the daughter cells produced have 46 **chromosomes** and are genetically identical to the original parent cell.
- In **meiosis** the daughter cells produced have 23 **chromosomes** and are genetically different to the original parent cell.
- **Mitosis** is for growth and repair of body cells, whereas **meiosis** is the formation of **gametes**.

Lesson 30: Refraction

1) Draw a ray diagram to represent the descriptions below. Remember to include the normal line and label the angle of incidence and angle of refraction. All rays are coming into the block at an angle from the normal.
(Order of density from most to least dense: Glass → Water → Air)

A ray of light passing from air into water.  	A ray of light passing from water into air. 
A ray of light passing from glass into air.  	A ray of light passing from air into water and then into glass. 

2) What are the three things a wave can do when it his a boundary between two different mediums?

- Reflect
- Transmit (leads to refraction)
- Absorb

Lesson 30: Refraction

3) Why does refraction happen to a wave?

Light changes speed when it moves from one medium into another medium due to different densities.

The part of the light that reaches the boundary first, changes speed first. This causes the wave to turn.

---

4) When a wave goes into a block at right angles to the surface refraction does not happen. Why?

This is because all of the wave slows at the same time because all of the wave will arrive at the block at the same time.

---

5) James set up an experiment as shown below:

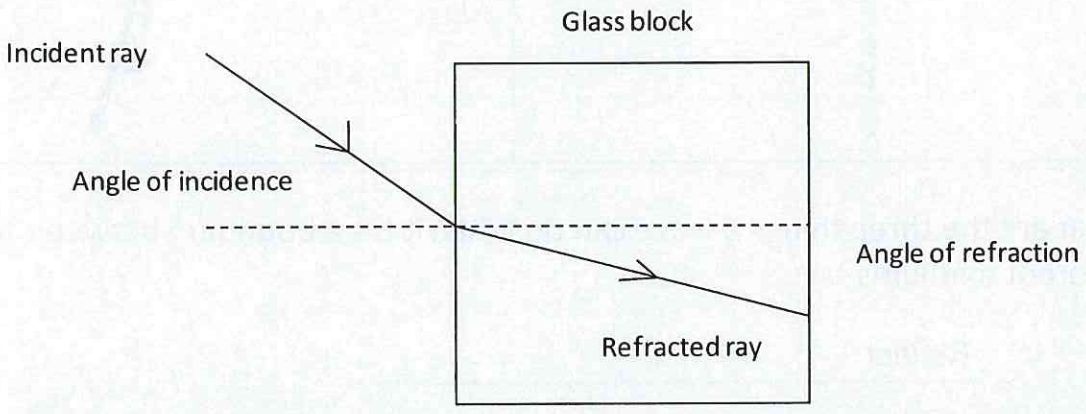
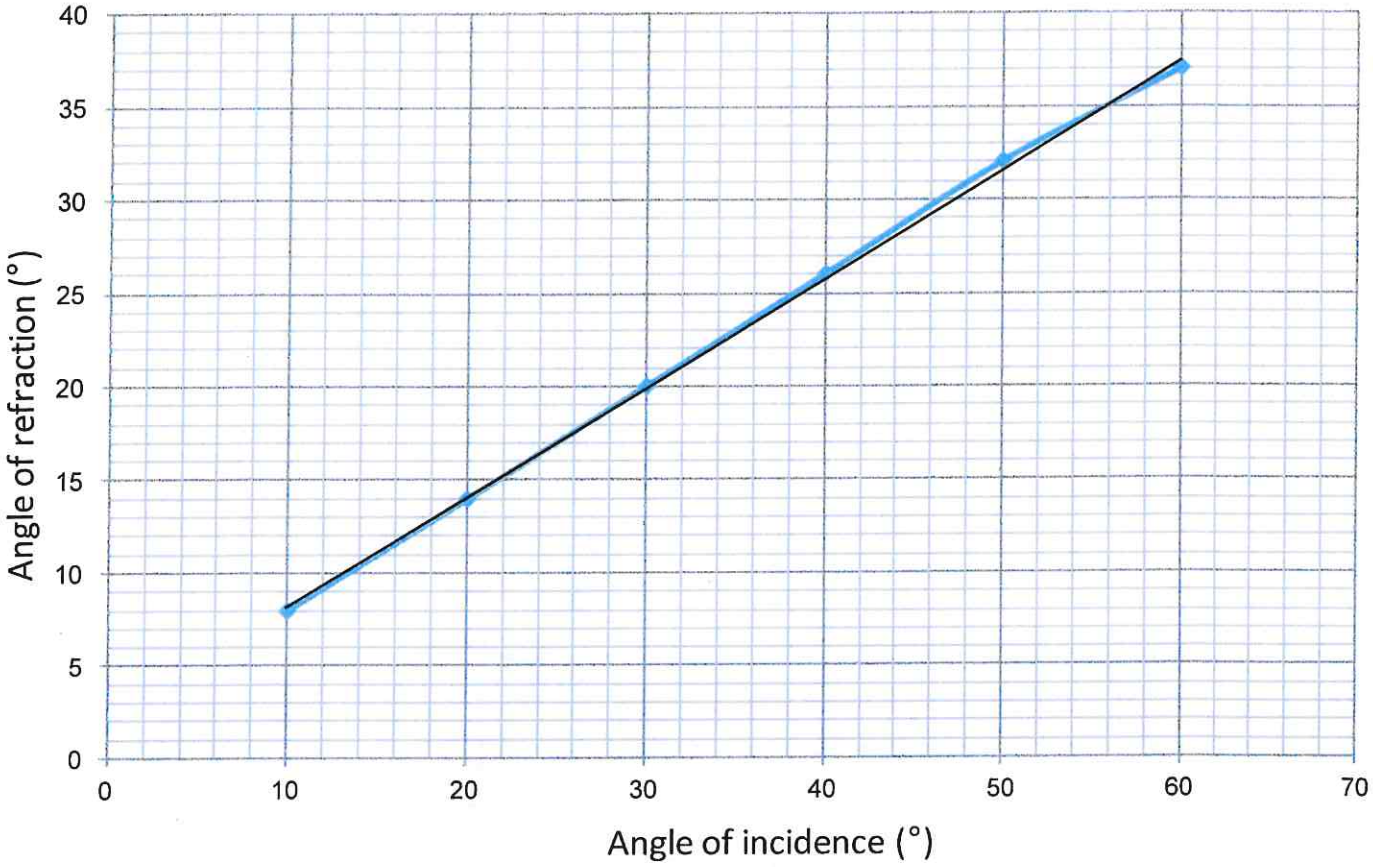


Diagram 2

Lesson 30: Refraction

He measured the angle of refection for different angles of incidence.
His results are shown in the graph.



a) Use the graph to answer the questions below:
When the angle of refraction is 20°, what is the angle of incidence?

14 °

b) What conclusion could James draw from his graph?

When light passes from air into glass, the angle of incidence is always

Greater than the angle of refraction.

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Lesson 30: Refraction

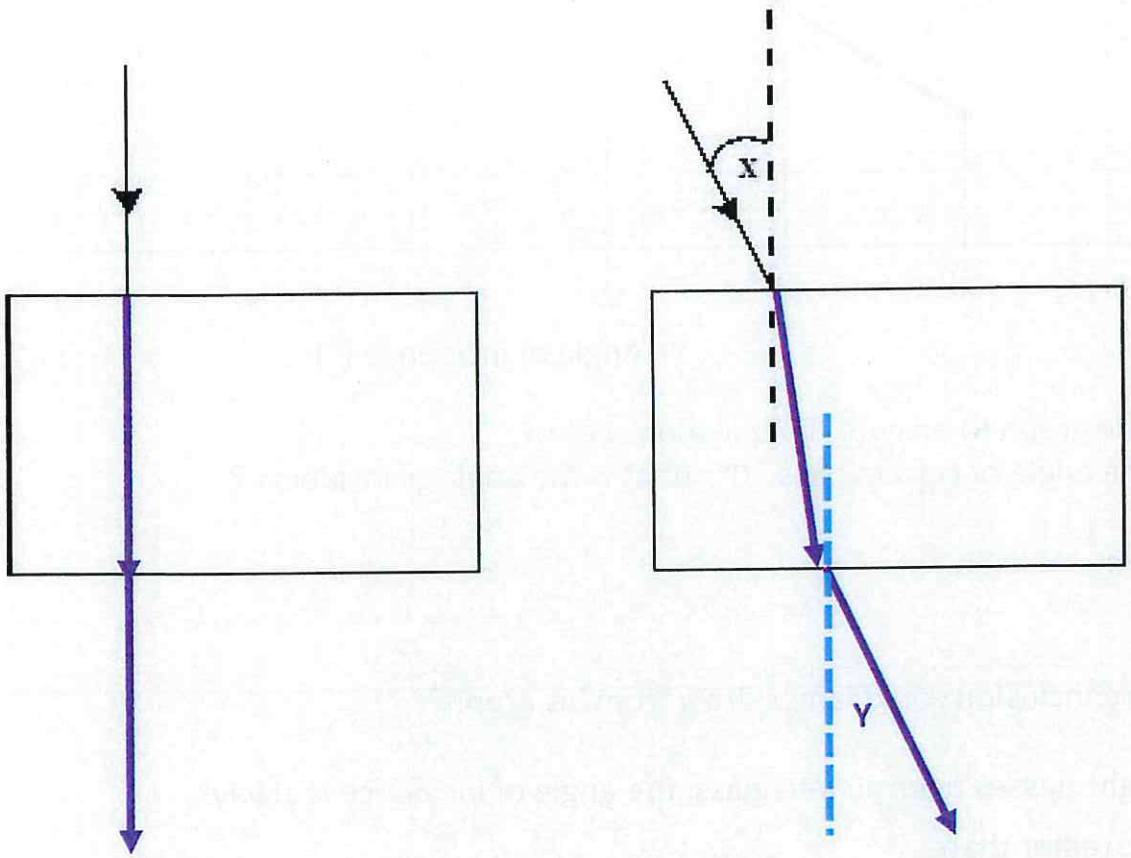
Exam questions

Q1.(a) The diagrams show rays of light. Each ray strikes a surface of a glass block.

i) On the diagram draw the path of each ray through the glass block and out into the air again.

ii) Label another angle on the diagram which is equal to the angle marked **X**.
Label this angle **Y**.

(4)

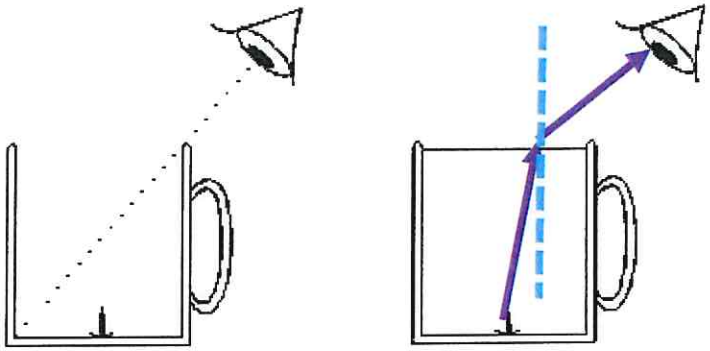


. Complete the ray diagram below.

Lesson 30: Refraction

Exam questions

b) The diagrams show two beakers. Both beakers have a drawing pin inside as



The first beaker is empty. The eye cannot see the drawing pin.
The second beaker is full of water and the eye can see the drawing pin.
Explain how the eye is able to see the drawing pin in the second beaker. You may add to the diagram if it helps your answer. **(3)**

- The water is a straight ray to water surface.
- The water surface refracts the light away from the normal.
- and straight to the eye.

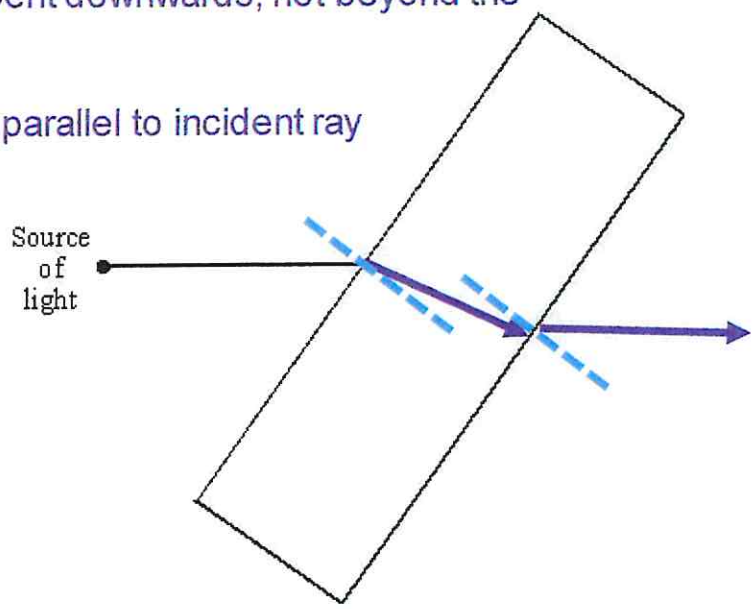
---

2) Light can also be made to change direction as it passes into and out from a block of glass. Complete the ray diagram below.

(2)

Ray in block bent downwards, not beyond the normal

Emergent ray parallel to incident ray



Lesson 31: Uses and Applications of Electromagnetic waves

1) Complete the Table below:

Most Energy	Type of EM radiation	Applications of the wave (uses)	Why is this type of radiation suitable?
	Gamma	Sterilise equipment, As a form of cancer treatment.	Transmitted through body tissues with very little absorption. Very high energy wave.
	Xray	Take x-rays to check for broken bones.	Transmitted through body tissues with very little absorption. Very high energy wave.
	Ultraviolet	Security markings, Sunbeds, energy efficient lamps, disinfecting water.	It can be absorbed as ultraviolet and re-emitted as visible light. Hazardous properties make it good to kill bacteria when disinfecting water.
	Visible Light	Fibre optics, communications.	Can travel easily though class fibre to allow for fibre optics. Humans can see visible light so can be used as a form of communication. E.g. Traffic lights tell us when to go and stop.
	Infrared	Electric heaters, cooking food, infrared cameras.	Infrared light has frequencies which are absorbed by some chemical bonds. The internal energy of the bonds increases when they absorb infrared light, which causes heating. Infrared cameras can detect it.
	Microwave	Satellite communication. Cooking food, satellite TV	Microwaves have enough energy to pass through the atmosphere but not enough energy to be dangerous. High frequency microwaves are easily absorbed by molecules in food and increases internal energy which causes heating.
Least Energy	Radio	Radio and Television.	Radio waves are transmitted easily through air. They do not cause damage if absorbed by the human body, and they can be reflected to change their direction.

Lesson 31: Uses and Applications of Electromagnetic waves

Exam questions

1. The figure below shows an incomplete electromagnetic spectrum.

A	microwaves	B	C	ultraviolet	D	gamma

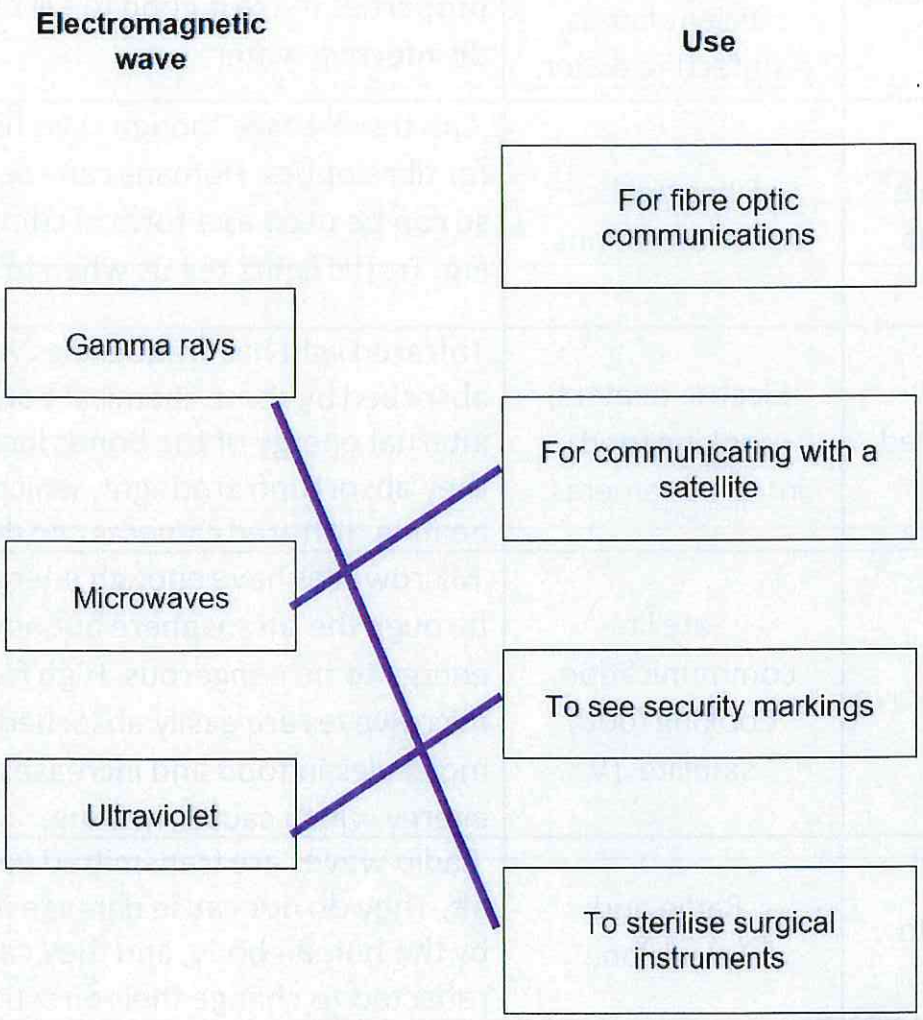
(a) What name is given to the group of waves at the position labelled A in the figure above?

Tick **one** box.

infrared [B] radio [A] visible light [C] X-ray [D]

(b) Electromagnetic waves have many practical uses.

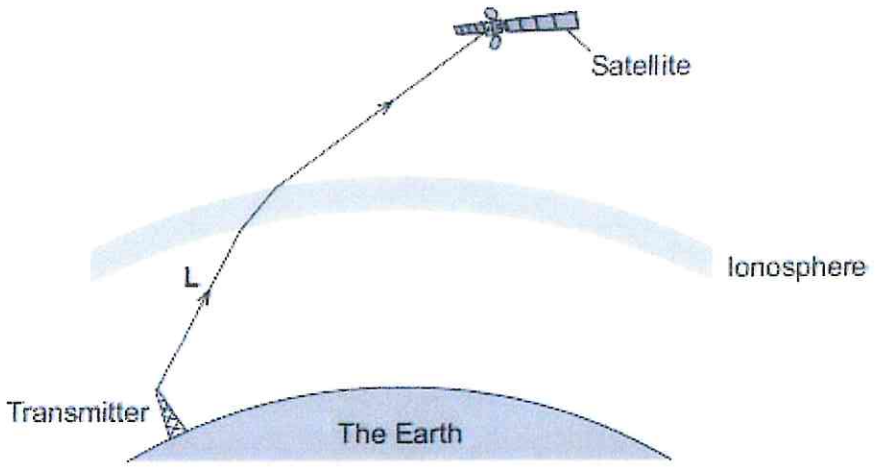
Draw **one** line from each type of electromagnetic wave to its use



Lesson 31: Uses and Applications of Electromagnetic waves

2 **Figure 2** shows a transmitter sending a signal to a satellite orbiting the Earth.

Figure 2



a). Which type of electromagnetic wave is used to send a signal to a satellite?
Draw a ring around the correct answer.

gamma **microwave** **ultraviolet**

(1)

b) After a person is injured a doctor will sometimes ask for a photograph to be taken of the patient's bone structure, e.g. in the case of a suspected broken arm.

(i) Which type of electromagnetic radiation would be used to take the photograph?

X-rays or gamma rays

(1)

(ii) Describe the properties of this radiation which enable it to be used to photograph bone structure.

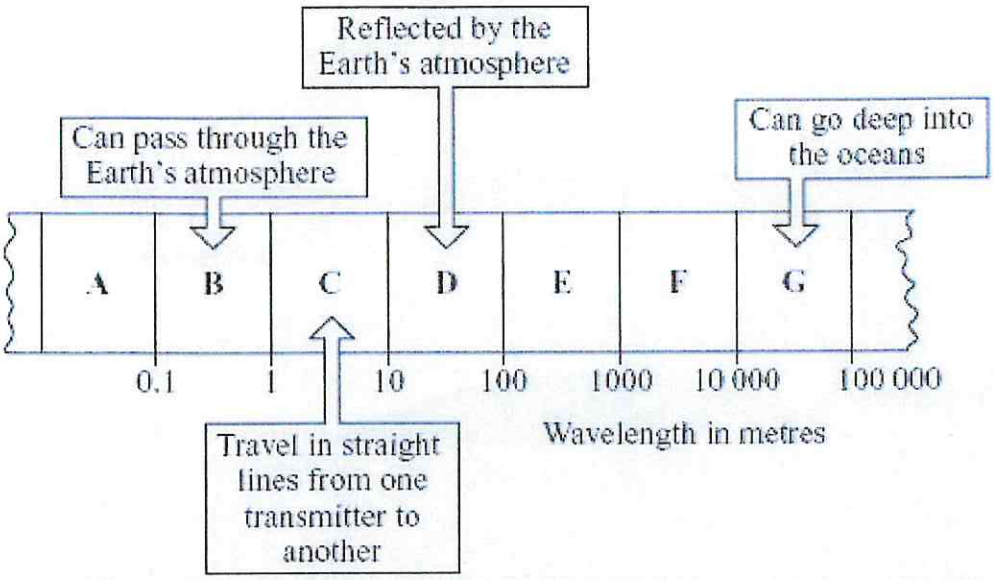
passes through flesh;

stopped by bone/absorbed

(2)

Lesson 31: Uses and Applications of Electromagnetic waves

3) The diagram shows a small part of the electromagnetic spectrum divided into seven sections. The different properties of the waves in each section make them useful in different ways.



The waves in which section, **A**, **B**, **C**, **D**, **E**, **F** or **G**, are:

(a) used to send a signal to a satellite in space B (1)

(b) used to communicate with a submarine under the water G (1)

(c) used by a radio station to broadcast programmes around the world D (1)

(d) the waves with the shortest wavelength? A (1)

Lesson 3b: HUMAN GENOME PROJECT

1. Define the term genome.

ENTIRE GENETIC MATERIAL IN AN ORGANISM

2. Why is the human genome project important.

- search for **genes** linked to different types of disease.
- understand inherited disorders and their treatment.
- trace human migration patterns from the past.

PONTEFRACT
ACADEMIES TRUST

OUT OF LESSON WORK

TERM 1

SCIENCE

YEAR 11

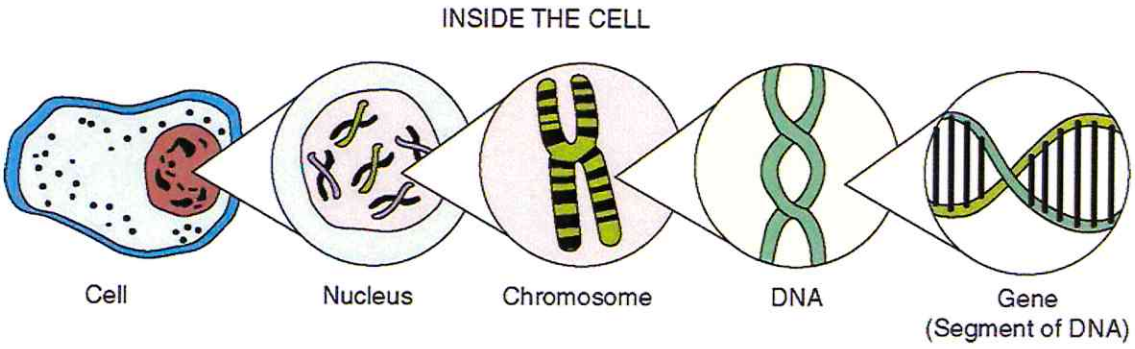
PONTEFRACT
ACADEMIES TRUST

Contents

PONTEFRACT

Lesson 1: WHERE IS THE GENETIC INFORMATION FOUND?

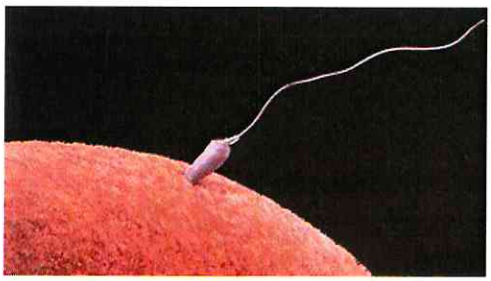
- In every cell there is a **nucleus**.
- Inside the **nucleus** there are chromosomes.
- Chromosomes are made of DNA.
- A section of DNA is a gene.



FERTILISATION

- What does this image show?

The sperm fertilising the egg cell.

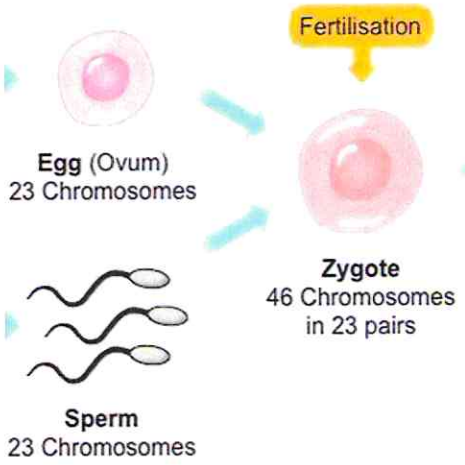


- **Fertilisation** is the fusion of the nuclei of the male **gamete** and the female **gamete**.
- The male **gamete** in humans is the **sperm** cell
- The female **gamete** in humans is the **egg** cell.
- The male **gamete** in plants is the **pollen** cell.
- The female **gamete** in plants is the **egg** cell.

WHAT IS SEXUAL REPRODUCTION?

PONTEFRACT

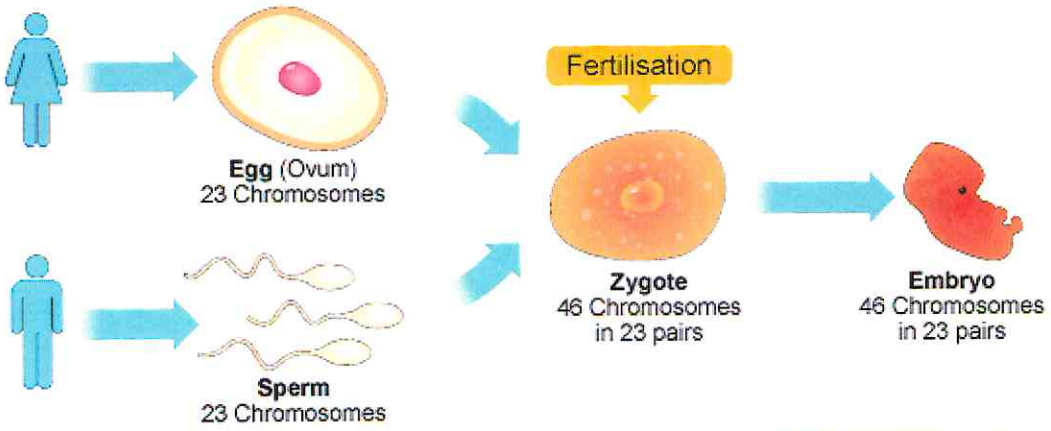
- Two parents are needed in **sexual reproduction**.
- During this process the nuclei of the male and female **gametes** are fused in order to create a zygote.
- This process is known as **fertilisation**.



FERTILISATION

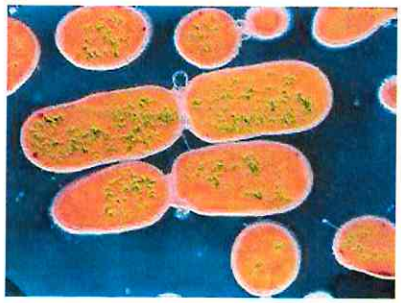
PONTEFRACT

- In **sexual reproduction**, the nuclei of the **egg** and the **sperm** cell (the **gametes**) fuse together at **fertilisation**, this creating 46 chromosomes, in 23 pairs.
- The zygote is a fertilised egg cell.



WHAT IS ASEXUAL REPRODUCTION?

- Only one parent is needed in **asexual reproduction**.
- There is no fusion of **gametes** so genetic material does not mix.
- This means that the offspring produced through this process are genetically identical **clones** to the parent.
- The image shows bacteria reproducing **asexually**.
- Bacteria, strawberries, potatoes and daffodils can all reproduce asexually.



WHAT ARE THE DIFFERENCES BETWEEN SEXUAL AND ASEXUAL REPRODUCTION?

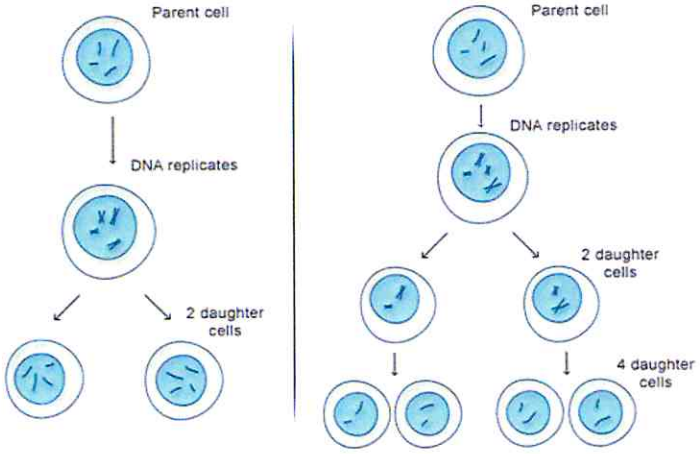
	Sexual	Asexual
How many parents?	2	1
Does it create variation?	Yes	No
Does it involve gametes?	Yes	No
Examples include?	Humans	Bacteria

Lesson 2: WHAT ARE THE TWO TYPES OF CELL DIVISION?

PONTEFRACT

- What are the two types of cell division?
  - Mitosis
  - Meiosis
- Which diagram opposite shows **mitosis**?

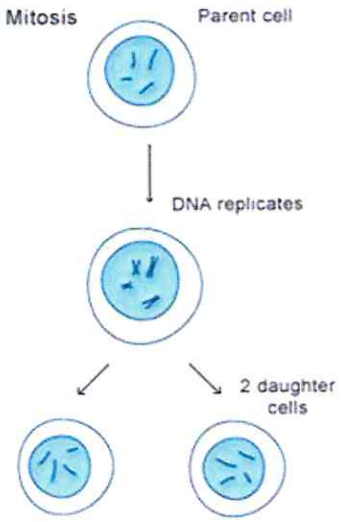
  Left diagram
- **Mitosis** is a type of cell division that produces cells that are genetically identical to the original.



WHAT IS MITOSIS?

PONTEFRACT

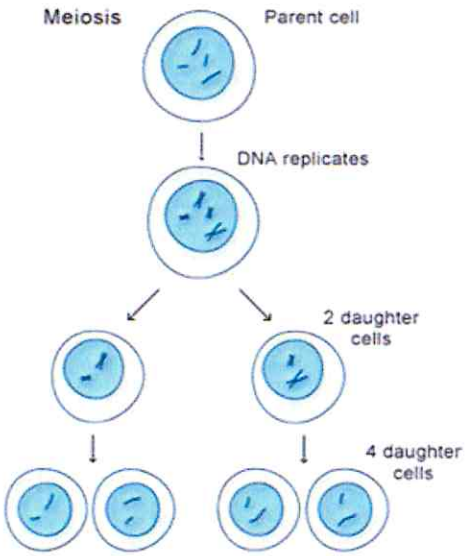
- What is **mitosis**?
- A type of cell division which produces daughter cells which are genetically identical to the parent.
- **Asexual reproduction** involves **mitosis** to produce the genetically identical copies of the parent cell.
- The cell only divides once and produces 2 daughter cells which have 46 **chromosomes** in each.
- **Mitosis** is for growth and repair of body cells.



WHAT IS MEIOSIS?

PONTEFRACT

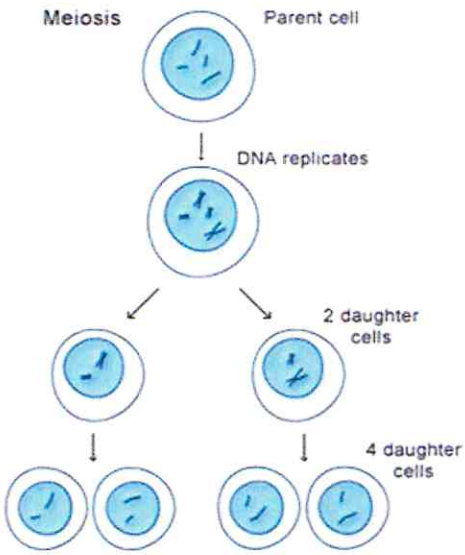
- **Meiosis** is the cell division that forms your **gametes**.
- What is the male **gamete**?
- Sperm
- What is the female **gamete**?
- Egg
- So in essence, the process of **meiosis** forms the **sperm** and **egg** cells.
- **Sexual reproduction** uses the process of **meiosis**, which creates **gametes**.



WHAT IS MEIOSIS?

PONTEFRACT

- The process of **meiosis** happens in the male and female reproductive organs.
- Where are the **sperm** cells formed?
- Testes.
- Where are the **egg** cells formed?
- Ovaries.
- So **meiosis** only occurs in the ovaries and the testes.

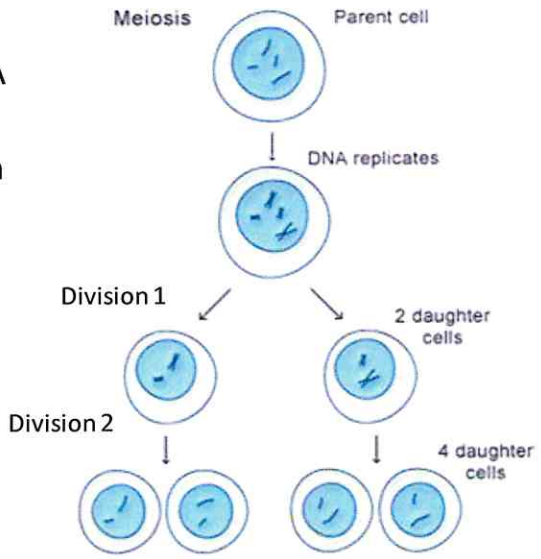


WHAT IS THE PROCESS OF MEIOSIS?

PONTEFRACT

As a cell divides to form **gametes**:

- Copies of the genetic information are made (DNA replicates)
- The cell divides twice to form four **gametes**, each with a single set of chromosomes (23)
- All **gametes** are genetically different from each other.



COMPARING MITOSIS AND MEIOSIS

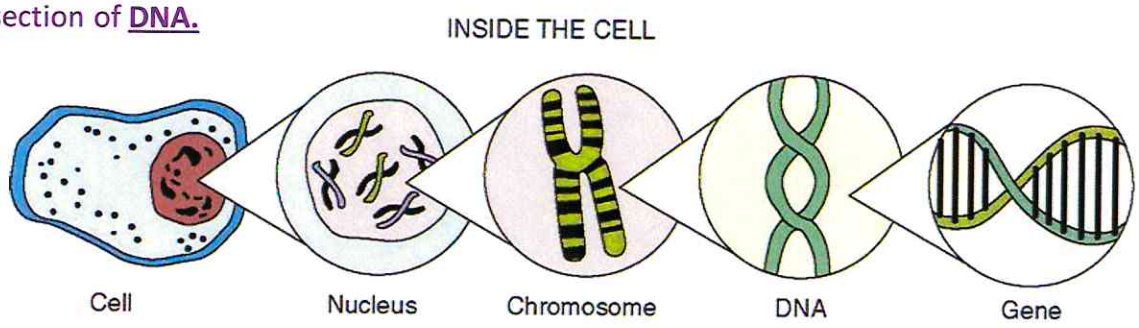
PONTEFRACT

	Mitosis	Meiosis
Role	Cell division of normal body cells (growth and repair)	Formation of gametes
Number of divisions	1	2
Genetically identical?	Yes	No – variation
Number of daughter cells?	2	4
Asexual or sexual?	Asexual	Sexual
Number of chromosomes in daughter cells	46	23

Lesson 3: WHERE IS THE GENETIC INFORMATION FOUND?

PONTEFRACT

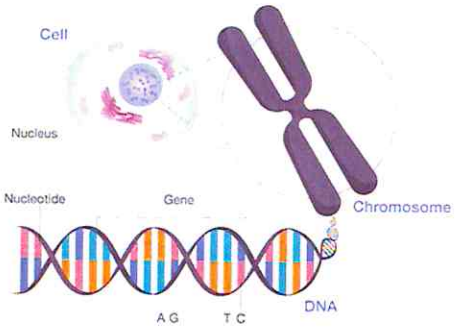
- In every cell there is a **nucleus**.
- What structures are found within the **nucleus**?
- **Chromosomes**
- What are **chromosomes** made of?
- **Chromosomes** are made of **DNA**.
- What is a **gene**?
- A section of **DNA.**



DNA STRUCTURE

PONTEFRACT

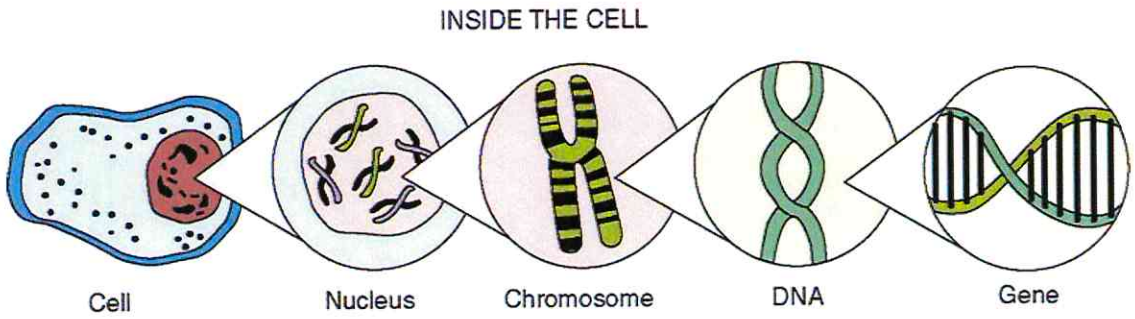
- The genetic material in the **nucleus** of a cell is composed of a chemical called **DNA**.
- **DNA** is contained within structures called **chromosomes**.
- DNA is a **polymer**, a large and complex molecule. It is made up of two strands forming a twisted ladder structure called a **double helix**.
- It carries the genetic code, which determines the characteristics of a living organism.



WHAT IS A GENE?

PONTEFRACT

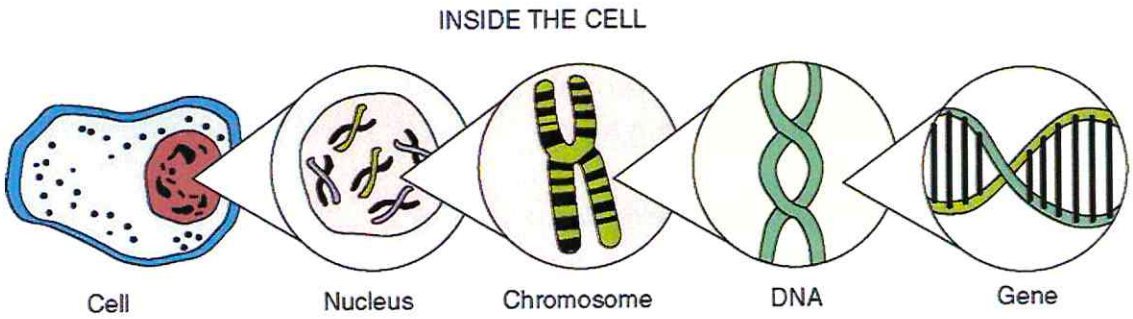
- What is a **gene**?
- A gene is a section of DNA.



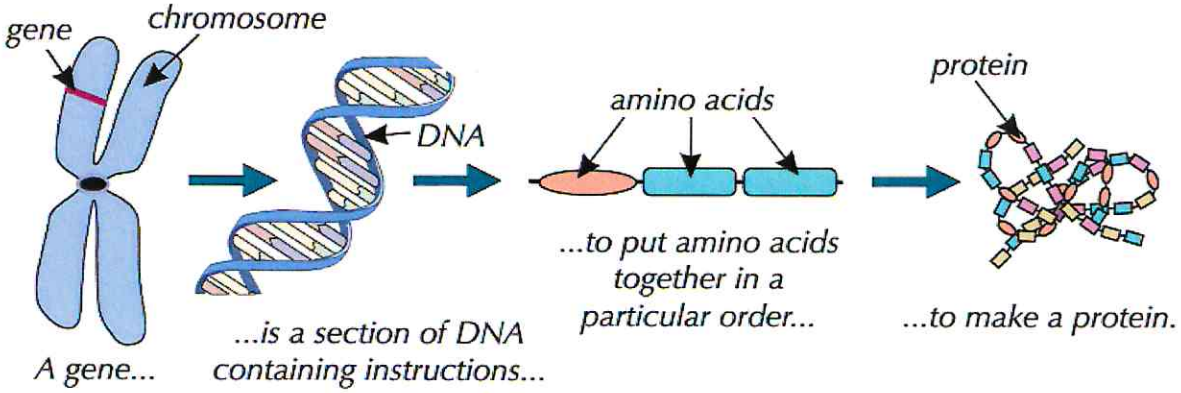
WHAT DO GENES CODE FOR?

PONTEFRACT

- What do **genes** code for?
- Each **gene** contains a code for a particular sequence of **amino acids**, to make a specific **protein**.

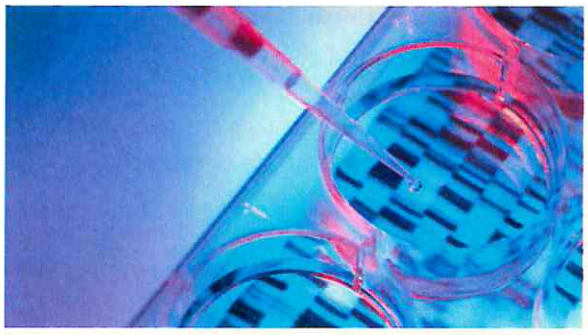


THE FUNCTION OF A GENE



WHAT IS THE HUMAN GENOME?

- What is the human **genome**?
- The **genome** of an organism is the entire **genetic** material of that organism.
- The whole human **genome** has been studied, and this has great importance for medicine.

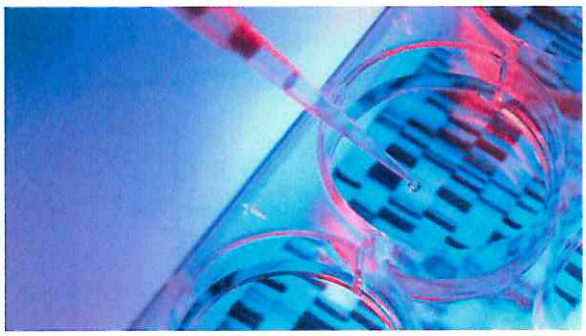


WHY IS THE HUMAN GENOME PROJECT IMPORTANT?

PONTEFRACT

- Why is the human **genome** project so important?

- It has allowed us to:
  - search for **genes** linked to different types of disease.
  - understand inherited disorders and their treatment.
  - trace human migration patterns from the past.



EXAMPLE OF IMPORTANCE OF HUMAN GENOME PROJECT

PONTEFRACT

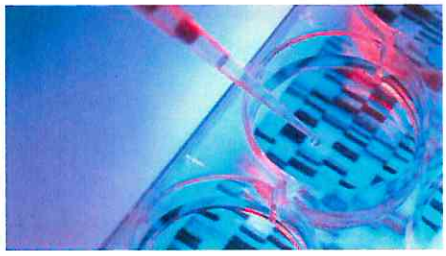
- Scientists are searching for disease associated **genes**.

- One example was those that can contribute to breast cancer, which are known as *BRCA1* and *BRCA2*.

- Mutations in these **genes** account for approximately 10% of all inherited breast cancer cases detected.

- Scientists detected *BRCA1* and *BRCA2* **genes** by studying families where breast cancer was known to have been inherited between individuals.

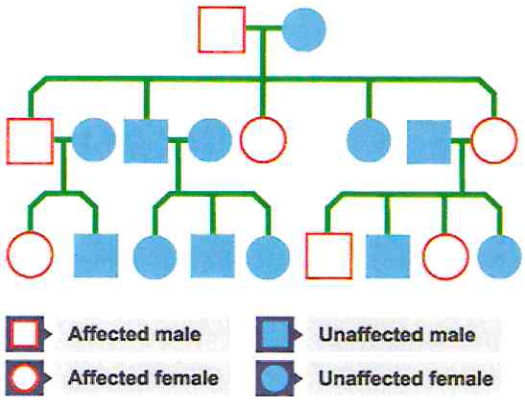
- They were able to create a pedigree analysis, which is similar to a family tree diagram that showed the close relationship of those affected and unaffected within the family.



EXAMPLE OF IMPORTANCE OF HUMAN GENOME PROJECT

PONTEFRACT

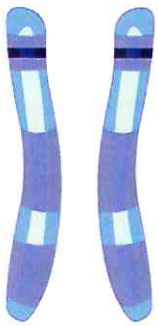
- The pedigree analysis illustrates the inheritance pattern of the disease to be determined.
- This enabled scientists to test **DNA** of the affected and unaffected individuals to identify differences.
- It is now possible to detect the presence of the **genes** by having a simple blood test.



Lesson 4: INHERITANCE

PONTEFRACT

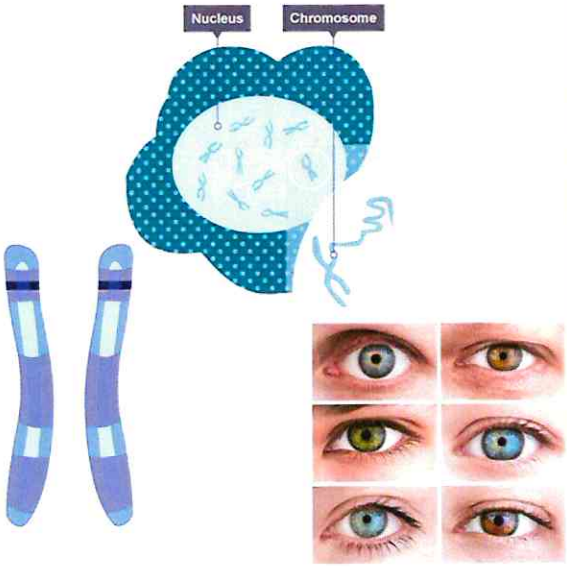
- Can you name an inherited characteristic?
- Eye colour.
- Hair colour.
- Genetic disorder.
- Some characteristics are controlled by a single **gene**, such as fur in animals and red-green colour blindness in humans.
- Each **gene** might have different forms, and these are called **alleles**.



CHROMOSOMES

PONTEFRACT

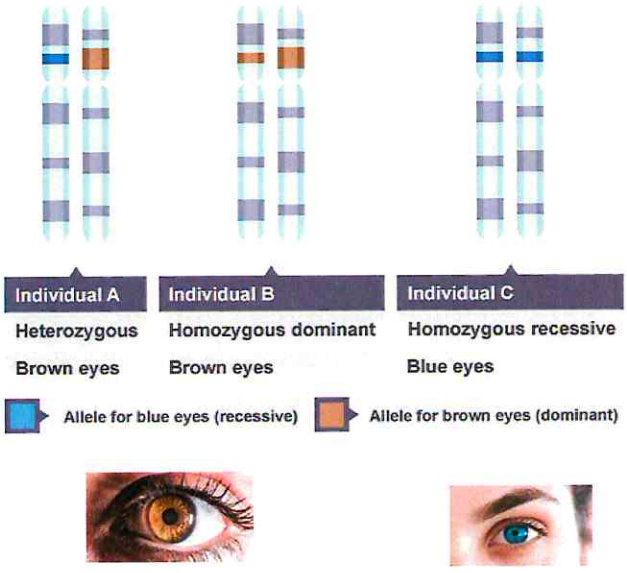
- **Chromosomes** are found in the **nucleus** of a body cell in pairs.
- Why are **chromosomes** found in pairs?
- Because one **chromosome** is inherited from the mother and one is inherited from the father.
- The **chromosome** in each pair carries the same **gene** in the same location.
- These **genes** could be the same, or different versions.
- An **allele** is a different version of the same **gene**.



ALLELES

PONTEFRACT

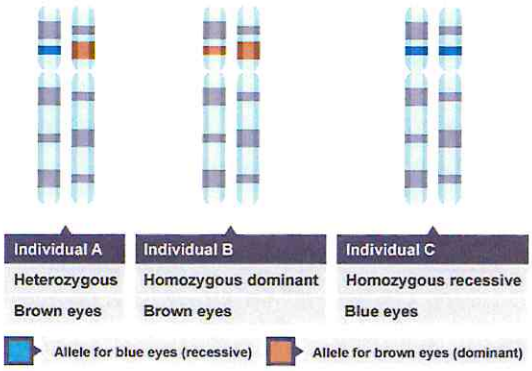
- **Alleles** are different versions of the same **gene**.
- For example, the **gene** for eye colour has an **allele** for blue eye colour and an **allele** for brown eye colour.
- For any gene, a person may have the same two **alleles**, known as **homozygous** or two different ones, known as **heterozygous**.



ALLELES

PONTEFRACT

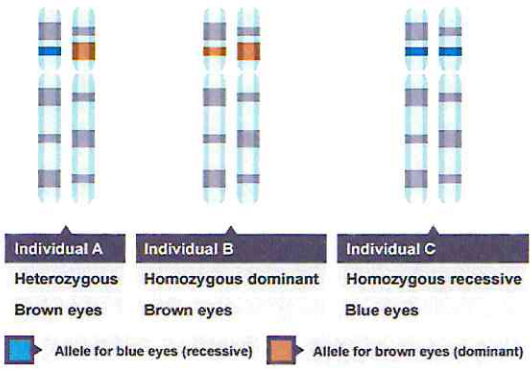
- **Alleles** are different versions of the same **gene**.
- The **genotype** is the collection of alleles that determine characteristics and can be expressed as a **phenotype**.
- Alleles can be **dominant** or **recessive**.



DOMINANT ALLELES

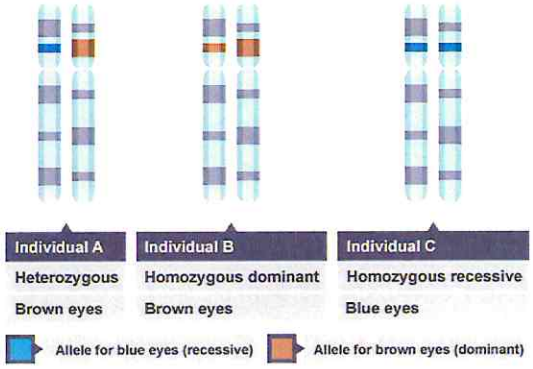
PONTEFRACT

- A **dominant allele** is always expressed, even if one copy is present.
- **Dominant alleles** are represented by a capital letter, for example, A.
- The allele for brown eyes is **dominant**. You only need one copy of this **allele** to have brown eyes.
- Two copies will still give you brown eyes.



RECESSIVE ALLELES

- A **recessive allele** is only expressed if the individual has two copies and does not have the **dominant allele** of that **gene**.
- **Recessive alleles** are represented by a lower case letter, for example, a.
- The **allele** for blue eyes is **recessive**. You need **two copies** of this **allele** to have blue eyes.
- Most characteristics are a result of multiple **genes** interacting, rather than a single **gene**.



CARRYING OUT A GENETIC CROSS

Worked example 1

- If the father is has brown eyes and his **genotype** is BB and the mother has blue eyes and her **genotype** is bb, what are the possible combinations of their offspring.
- What is the only **phenotype** of their offspring in this example?
- Brown eyes.
- What is the only **genotype** of their offspring in this example?
- Bb

TASK

Complete this Punnett square to show the possible allele combinations of the offspring
The **mother is bb** - blue eyes
The **father is BB** - brown eyes

	b	b
B	Bb	Bb
B	Bb	Bb

CARRYING OUT A GENETIC CROSS

PONTEFRACT

Worked example 1
The mother is bb – blue eyes
The father is BB – brown eyes

Outcomes for offspring
The **genotype** is Bb
The **phenotype** is brown eyes.

Because there are two different **alleles**, (one dominant and one recessive) it is **heterozygous**.

	b	b
B	Bb	Bb
B	Bb	Bb

Note - You should always write the **dominant allele** first.

CARRYING OUT A GENETIC CROSS

PONTEFRACT

Worked example 2

- The height of pea plants is controlled by a single **gene** which has two **alleles**: tall and short.
- The tall **allele** is **dominant** and is shown as T.
- The small **allele** is **recessive** and is shown as t.
- What is the only **phenotype** of their offspring in this example?
- Tall plants
- What is the only **genotype** of their offspring in this example?
- Tt

TASK
Complete this Punnett square to show the possible allele combinations of the offspring produced when two pea plants are bred.
The **female is TT** - tall
The **male is tt** - short

	T	T
t	Tt	Tt
t	Tt	Tt

CARRYING OUT A GENETIC CROSS

PONTEFRACT

Worked example 2
The female plant **is TT** - tall
The male plant **is tt** - short

Outcomes
The **genotype** is Tt
The **phenotype** is tall plant.

Because there are two different **alleles**, it is **heterozygous**.

	T	T
t	Tt	Tt
t	Tt	Tt

Lesson 5: INHERITED DISORDERS

PONTEFRACT

- Some disorders are inherited.
- These disorders are caused by the inheritance of certain **alleles**.
- **Polydactyly** (having extra fingers or toes) is caused by a **dominant allele**.
- **Cystic fibrosis** (a disorder of cell membranes) is caused by a **recessive allele**.

CYSTIC FIBROSIS

PONTEFRACT

- **Cystic fibrosis** is an inherited disorder of cell membranes that mainly affects the lungs and digestive system.
- They can become clogged with lots of thick, sticky mucus as too much is produced.
- Over many years, the lungs become increasingly damaged and may eventually stop working properly.
- People who have **cystic fibrosis** have a reduced life expectancy.

HOW DO YOU INHERIT CYSTIC FIBROSIS?

PONTEFRACT

- It is caused by a faulty **recessive allele** on **chromosome** 7.
- To be born with **cystic fibrosis**, a child has to inherit two copies of this faulty **allele** - one from each of their parents.
- Their parents will not usually have the condition themselves, because they will only carry one faulty gene and one that works normally.

HOW DO YOU INHERIT CYSTIC FIBROSIS?

PONTEFRACT

- An individual who is **homozygous** (ff) with the recessive **allele** will develop **cystic fibrosis**.
- Someone who is **heterozygous** (Ff) will be a carrier of the **recessive allele**, but will not develop **cystic fibrosis** and have no symptoms.
- Someone who is **homozygous** with the **dominant allele** (FF) will not develop **cystic fibrosis**, as you need two faulty **alleles** (ff) for the condition. In this combination, no faulty **alleles** are present.

- FF = no cystic fibrosis
- Ff = no cystic fibrosis but a **carrier**
- ff = has cystic fibrosis

WHAT DOES IT MEAN TO BE A CARRIER?

PONTEFRACT

- A **carrier** would have a copy of a faulty **allele** that codes for an inherited disorder, but not have the disorder themselves.
- A **carrier** can potentially pass on the inherited disorder to their children.

- FF = no **cystic fibrosis**
- Ff = no **cystic fibrosis** but a **carrier**
- ff = has **cystic fibrosis**

HOW DOES THIS APPEAR IN A GENETIC CROSS DIAGRAM?

PONTEFRACT

Both parents are **heterozygous**, Ff, what is the % chance of their child having **cystic fibrosis**?

25%

	F	f
F	FF	Ff
f	Ff	ff

- FF = no **cystic fibrosis**
- Ff = no **cystic fibrosis** but a **carrier**
- ff = has **cystic fibrosis**

HOW DOES THIS APPEAR IN A GENETIC CROSS DIAGRAM?

PONTEFRACT

What if only one parent is **heterozygous**, Ff, and the other parent does not have **cystic fibrosis** and is not a **carrier**. What is the % chance of their child having **cystic fibrosis**?

	F	F
F	FF	FF
f	Ff	Ff

- FF = no **cystic fibrosis**
- Ff = no **cystic fibrosis** but a **carrier**
- ff = has **cystic fibrosis**

0% chance of having a child with **cystic fibrosis**. But 50% chance of having a child who is a **carrier** for the disorder.

POLYDACTYLY

PONTEFRACT

- **Polydactyly** is an inherited condition in which a person has extra fingers or toes.
- It is caused by a **dominant allele** of a **gene**.
- This means it can be passed on by just one **allele** from one parent if they have the disorder.
- In terms of the **alleles**, how is **polydactyly** different from **cystic fibrosis?**
- **Polydactyly** is caused by a **dominant allele** and **cystic fibrosis** is caused by a **recessive allele**.

HOW DO YOU INHERIT POLYDACTYLY

PONTEFRACT

- Offspring need to carry just one **dominant** allele from their parents to inherit the **polydactyly** condition.
- The **genotypes** are:
  - DD = has **polydactyly**
  - Dd = has **polydactyly**
  - Dd = does not have **polydactyly**

HOW DOES THIS APPEAR IN A GENETIC CROSS DIAGRAM?

If one parent has **polydactyly** and has the **genotype** DD and one parent does not (dd), what is the % chance of their children having **polydactyly**?

	D	D
d	Dd	Dd
d	Dd	Dd

100% of having a child with polydactyly

- DD = has **polydactyly**
- Dd = has **polydactyly**
- Dd = does not have **polydactyly**

HOW DOES THIS APPEAR IN A GENETIC CROSS DIAGRAM? (HIGHER)

- If both parents have **polydactyly**, how is it possible that they could have a child without **polydactyly**?
- What would their **genotypes** be?

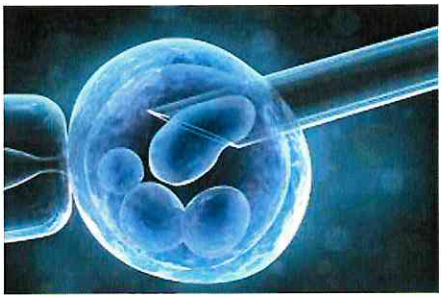
	D	d
D	DD	Dd
d	Dd	dd

- Which **genotype** does not have **polydactyly**?
- dd

GENETIC TESTING

PONTEFRACT

- Genetic testing involves analysis of a person's **DNA** to see if they carry **alleles** that cause inherited disorders.
- It can be done at any stage in a person's life.
- One of the main genetic tests is pre implantation genetic diagnosis (PGD).
- This is also known as **embryo** screening.



EMBRYO SCREENING

PONTEFRACT

What is **embryo** screening?

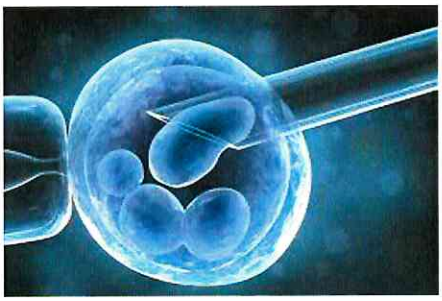
Screening an **embryo** for an inherited disorder.

Embryos are screened before implantation.

Once the **embryos** have reached the eight-cell stage, one cell is removed.

The cells are tested for the disorder causing **alleles**.

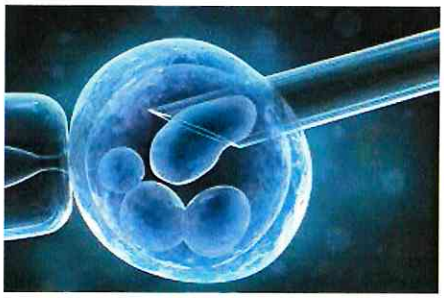
Embryos that don't contain the disorder **allele** are implanted into the uterus.



WHAT ARE THE ISSUES SURROUNDING EMBRYO SCREENING?

PONTEFRACT

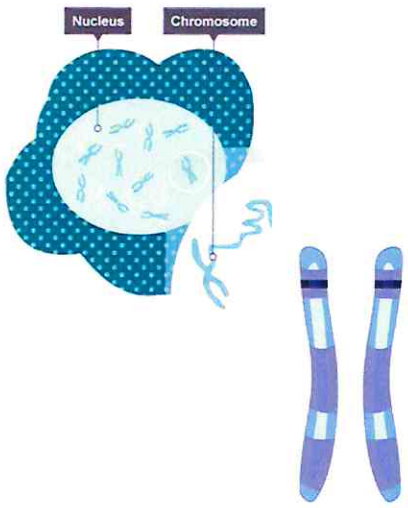
Arguments for embryo screening	Arguments against embryo screening
Reduce health care costs	Possible damage/risk to embryo
Reduce number of people in a population with inherited disorders	Possible risk to mother
Allows people to make a choice about termination	People may have to make a difficult decision regarding whether to keep the embryo
	Some groups view the 8 week old embryo as a life and are against this process as the termination of the embryo is seen as destroying potential human life



Lesson 6: CHROMOSOMES AND THE NUCLEUS

PONTEFRACT

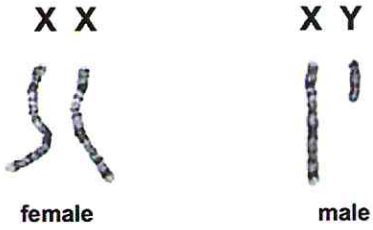
- **Chromosomes** are found in the **nucleus** of a body cell in pairs.
- Why are **chromosomes** found in pairs?
- Because one **chromosome** is inherited from the mother and one is inherited from the father.
- The **chromosome** in each pair carries the same **gene** in the same location.
- These **genes** could be the same, or different versions.
- An **allele** is a different version of the same **gene**.



SEX DETERMINATION

PONTEFRACT

- Out of the 23 pairs of **chromosomes**, 1 pair carries **genes** that determine the sex – whether the offspring are male of female.
- Males have two different sex **chromosomes**, **XY**
- Females have two X **chromosomes**, **XX**

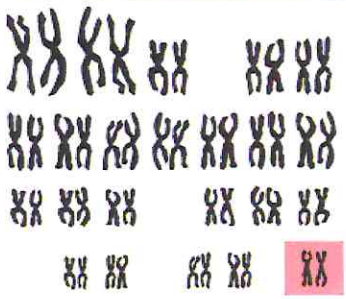


HOW DOES THIS APPEAR IN A GENETIC CROSS DIAGRAM?

PONTEFRACT

How can we use a genetic cross diagram for sex determination?

Father \ Mother	X	X
X	XX	XX
Y	XY	XY



- What % of the offspring are male?
- 50%
- What % of the offspring are female?
- 50%

Lesson 7: VARIATION

PONTEFRACT

- What does **variation** mean?
- **Variation** is the differences between individuals.
- Individuals in a population are usually similar to each other, but not identical.
- Some of the **variation** within a **species** is **inherited**, some is **environmental** - the conditions in which they have developed.
- Some is a combination of both **inherited** and **environmental** variation.

VARIATION

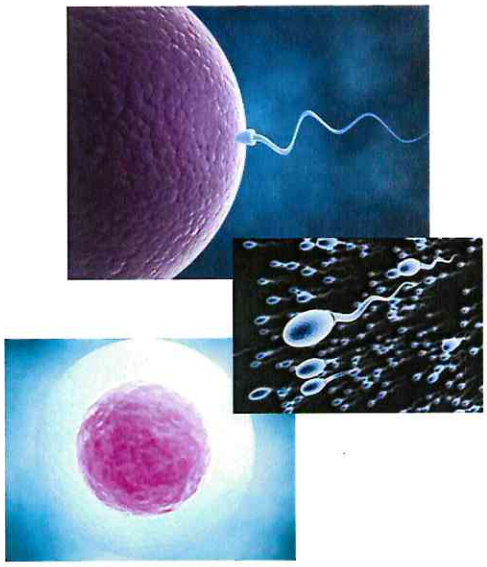
PONTEFRACT

- Why do children generally look a little like their mother and their father, but are not identical to either?
- They inherit their features (**characteristics**) from each parent's **DNA**.
- What is the male sex cell (gamete) called?
- **Sperm**
- What is the female sex cell (gamete) called?
- **Egg**

VARIATION

PONTEFRACT

- Every **sperm** and **egg** cell contains half of the **genetic** information needed for an individual.
- Each sex cell is known as **haploid**, which has half the normal number of **chromosomes**.
- When the **chromosomes** fuse during **fertilisation**, a new cell is formed, which is known as a **zygote**.
- It has all the **genetic** information needed for an individual, which is known as **diploid** and has the full number of **chromosomes**.
- How many is the 'full' number of **chromosomes** in humans?
- 46



FERTILISATION

PONTEFRACT

VARIATION

PONTEFRACT

- Can you name any **inherited characteristics**?
- Can you name any **environmental characteristics**?

Inherited	Environmental
Eye colour	Accent
Natural hair colour	Tattoos
Blood group	Scars

ENVIRONMENTAL VARIATION

PONTEFRACT

- **Characteristics** of animal and plant species can be affected by factors such as climate, diet, accidents, culture and lifestyle.
- For example, if you eat too much you will become heavier, and if you eat too little you will become lighter.
- A plant in the shade of a big tree will grow taller to reach more light.

ENVIRONMENTAL VARIATION EXAMPLES

PONTEFRACT

- Other examples of features that show **environmental** **variation** include:
  - scars
  - language and accent
  - flower colour in hydrangeas as these plants produce blue flowers in acidic soil and pink flowers in alkaline soil

ENVIRONMENTAL AND INHERITED VARIATION

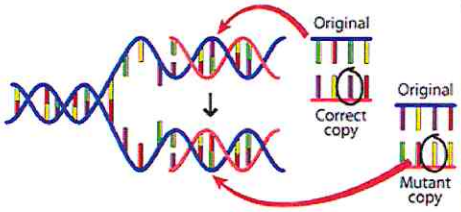
PONTEFRACT

- Are there any **characteristics** that are influenced by both **environmental** and **inherited** variation?
- Height
- Explain why this is.
- Tall parents will pass **genes** to their children for height.
- Their children have the **genetic** potential to also be tall.
- However, if their diet is poor then they will not grow very well: their environment also has an impact on their height.

MUTATIONS AND VARIATION

PONTEFRACT

- **Variation** within **genes** leads to different **genotypes**, and this can be seen by a different **phenotype**.



- What is a **genotype**?
- The alleles that an organism has for a particular **characteristic**, usually represented by letters.
- What is a **phenotype**?
- The visible **characteristics** that an organism has, as a result of its **genes**.

MUTATIONS AND VARIATION

PONTEFRACT

- **Inherited** and **environmental** **variation** combine together to produce these different **phenotypes**.
- All variants arise from **mutations** and most have no effect on the **phenotype**.
- What is a **mutation**?
- A random and spontaneous change in the structure of a **gene**, **chromosome** or number of **chromosomes**.
- When can **mutations** occur?
- Spontaneous, during cell division, through ionising radiation.

MUTATIONS AND PHENOTYPES

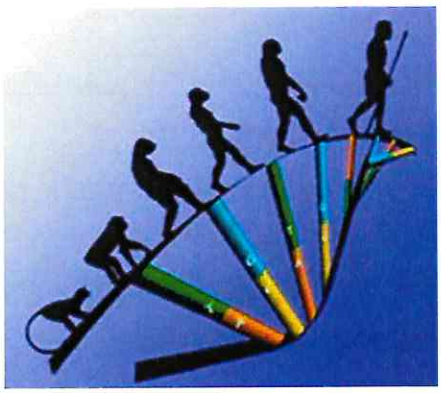
PONTEFRACT

- A **mutation** rarely creates a new **phenotype**, but if the **phenotype** is suited to a particular **environment**, it can lead to rapid change in a **species**.
- For example, if a **mutation** leads to a change, such as feather colouring in birds, this new change may allow those individuals to reproduce more frequently, due to them being more attractive and seen as a more desirable mate.
- This would result in this **phenotype** being passed on more successfully than the birds of the same species without the new **phenotype**.

Lesson 8: WHAT IS EVOLUTION?

PONTEFRACT

- **Evolution** is the change in the **inherited characteristics** of a population over time through a process of **natural selection** which may result in the formation of a new **species**.
- **Evolution** is based on the theory that all species of all living organisms have evolved from simple life forms over millions of years.



WHAT IS NATURAL SELECTION?

PONTEFRACT

- Here is a picture of some peppered moths.
- How many moths can you spot on this diagram?
  2
- Which is easier to see?
  The darker variety.
- Which one is more likely to get eaten by birds?
  The darker variety.

WHAT IS NATURAL SELECTION?

PONTEFRACT

- What about now? Which moth is easier to see?
  The lighter variety.
- Which one is more likely to get eaten by birds?
  The lighter variety.
- What will happen to their population numbers?
- The number of light moths will decrease as more are getting eaten
- The number of dark moths will increase.

WHAT IS NATURAL SELECTION?

PONTEFRACT

- The dark moth variety was caused by a **mutation** in the moths genes.
- What is a **mutation**?
- A mutation is a random or spontaneous change in a **gene**, chromosome, or number of chromosomes.
- Very often, **natural selection** is driven by a random **mutation** in a species **genes**.

WHAT IS NATURAL SELECTION?

PONTEFRACT

- Individuals in a **species** show a wide range of **variation** and this **variation** is because of differences in their **genes**. This can be as a result of a random **mutation**.
- Individuals with characteristics most suited to their environment are more likely to **survive** and reproduce so their **genes** are passed onto the next generation.
- Those that are poorly adapted to their environment are less likely to **survive** and reproduce. Their **genes** are less likely to be passed on to the next generation.

WHAT IS NATURAL SELECTION?

PONTEFRACT

- How can we apply this to peppered moth example?

- There is **variation** between the moths due to differences in their **genes**. This can be as a result of a random **mutation**.
- The black moth is more likely to **survive** because it is more camouflaged so less likely to be seen and eaten by birds.
- The white moth is more likely to be eaten as it is easier to see.
- The black moth is more likely to **survive** and **reproduce** and pass on its **genes** to its offspring.
- Therefore the numbers of black moths in a population increases.

WHAT IS NATURAL SELECTION?

PONTEFRACT

Key points

1. There is **variation** due to differences in genes.
2. This can be as a result of a random **mutation.**
3. Individuals with **characteristics** most suited to the environment **survive.**
4. They **survive**, reproduce and pass on their **genes** to their offspring.

This can be referred to as 'survival of the fittest' or **natural selection**.

WHAT IS NATURAL SELECTION?

PONTEFRACT

There is **variation** due to differences in genes.

This can be as a result of a random **mutation**

Those individuals with **characteristics** most suited to the environment **survive.**

They **survive**, reproduce and pass on their **genes** to their offspring.

WHAT IS NATURAL SELECTION - REHEARSAL

PONTEFRACT

- How can we describe the differences between the moths and what is this caused by?
  - There is **variation** between the moths due to differences in their **genes**. This can be as a result of a random **mutation**.
- Which moth is more likely to **survive** and why?
  - The black moth is more likely to **survive** because it is more camouflaged so less likely to be seen and eaten by birds.

WHAT IS NATURAL SELECTION - REHEARSAL

PONTEFRACT

- Which moth is more likely to not **survive** and why?
  - The white moth is more likely to be eaten as it is easier to see.
- What happens to the numbers of the black and white moths and why?
  - The black moth is more likely to **survive** and **reproduce** and pass on its **genes** to its offspring.
  - Therefore the numbers of black moths in a population increases.

NATURAL SELECTION AND PHENOTYPES.

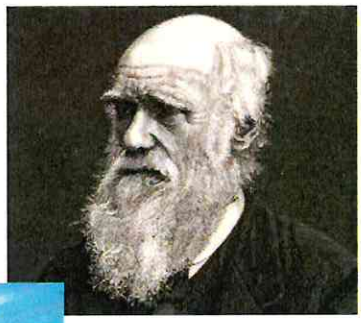
PONTEFRACT

- Over time, those that are poorly adapted to their environment are less likely to survive and reproduce.
- Their **genes** are less likely to be passed on to the next generation.
- Over a period of time, a species will gradually evolve.
- Remember both genes and the environment can cause variation, but only genetic variation can be passed on to the next generation.
- If two populations of one species become increasingly different in **phenotype** that they can no longer interbreed to form fertile offspring, this can result in the formation of two species.

THE SCIENTIST BEHIND THE THEORY

PONTEFRACT

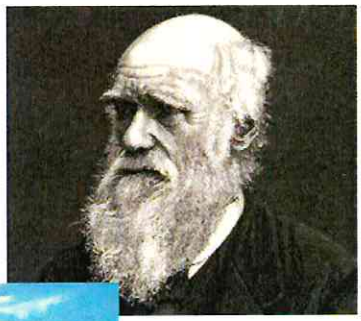
- Who is this scientist?
- Charles Darwin
- Charles Darwin studied variation in plants, animals and fossils during a five-year voyage around the world in the 19th century.



THE SCIENTIST BEHIND THE THEORY

PONTEFRACT

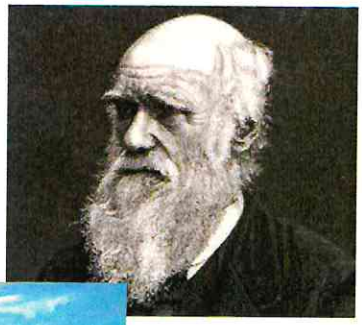
- Why did people disagree with Darwin's theory?
- Darwin's theory of evolution challenged the idea that God made all the animals and plants that live on Earth, which contradicted the commonly held Christian views of his era.



THE SCIENTIST BEHIND THE THEORY

PONTEFRACT

- Why was Darwin's theory not accepted initially?



- There was insufficient evidence
- The mechanism of inheritance (DNA) and variation was not known.

Lesson 9: SPECIATION

PONTEFRACT

- What is a **species**?

A **species** is a group of organisms able to interbreed and produce fertile offspring.

- How can new **species** arise?

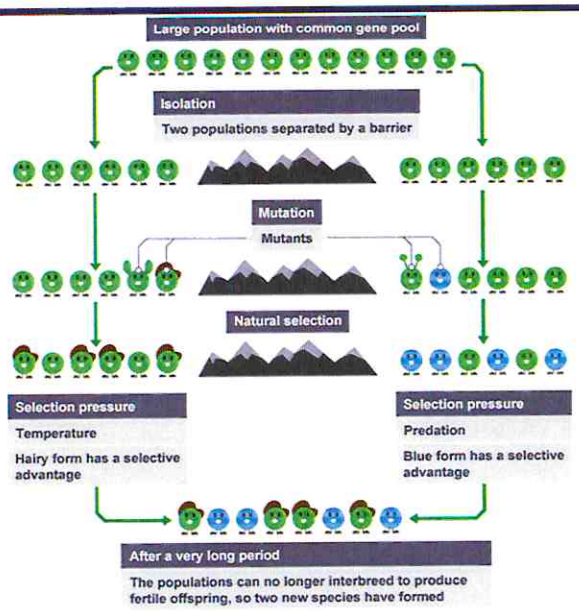
New species can arise as a result of the following things:

- Genetic **variation** - each population has a wide range of **alleles** that can control their characteristics
- **Natural selection** - the alleles which help an **organism** to survive are selected in each population
- **Speciation** - the populations become extremely varied and successful interbreeding cannot happen anymore

SPECIATION

PONTEFRACT

- What is **speciation**?
- **Speciation** is the formation of two or more **species** from the original **species**.

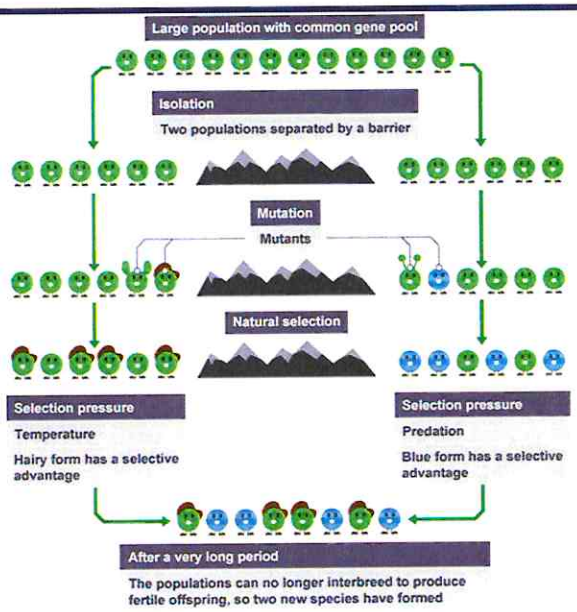


SPECIATION

PONTEFRACT

Describe the stages in **speciation**.

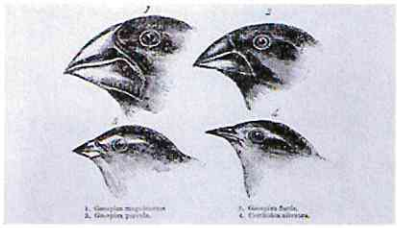
- Two populations of a **species** can become geographically separated because of the environment.
- **Isolation** can prevent interbreeding and the combination of **genes** within a **species**.
- Different **mutations** can take place in the isolated groups and create different **phenotypes** within a particular location.
- Over time **species** may evolve to be different to each other, and they will not be able to interbreed.



SPECIATION IN DARWIN'S FINCHES

PONTEFRACT

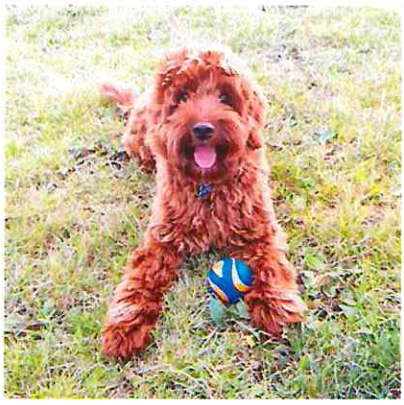
- Charles **Darwin** described the **speciation** of finches after his studies of the birds on the Galapágos Islands, which are a group of islands roughly 1,000 km off the coast of Ecuador.
- **Darwin** noticed that the finches on the different islands were similar to each other.
- However, **Darwin's** studies revealed that the finches had wide variations in their size, beaks and claws from island to island.
- The finches' beaks differed depending on the local food source. **Darwin** concluded that because the islands were distant from the mainland, the finches that had arrived there had changed over time.



Lesson 10: SELECTIVE BREEDING

PONTEFRACT

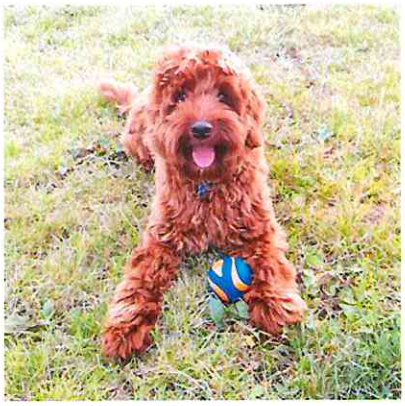
- What is **selective breeding**?
- **Selective breeding** or **artificial selection** is when humans breed plants and animals for particular **genetic** characteristics.
- Humans have bred food crops from wild plants and domesticated animals for thousands of years.



THE STAGES OF SELECTIVE BREEDING

PONTEFRACT

- What are the main stages of **selective breeding**?



1. Decide which **characteristics** are important enough to select.
2. Choose parents that show these **characteristics** from a mixed population. They are bred together.
3. Choose the best **offspring** with the desired **characteristics** to produce the next **generation**.
4. Repeat the process continuously over many **generations**, until all **offspring** show the desired **characteristics**.

EXAMPLES OF SELECTIVE BREEDING

PONTEFRACT

- Highland cows have been bred for their meat.
- Fresian cows have been bred to produce large volumes of milk.
- Aberdeen angus cows have also been bred for their meat.

DESIRABLE CHARACTERISTICS IN ANIMALS

What would be the desirable **characteristics** in cows?

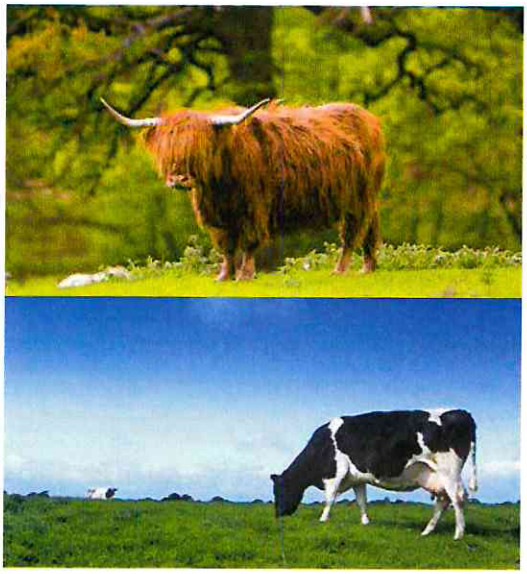
- Animals that produce lots of milk or meat.

What would be the desirable **characteristics** in chickens?

- Chickens that lay large eggs.

What would be the desirable **characteristics** in dogs?

- Domestic dogs that have a gentle nature.



DESIRABLE CHARACTERISTICS IN PLANTS

- What would be the desirable **characteristics** in food crops and wheat plants?

- Disease resistant.
- Produce lots of grain.

The new varieties may be economically important.

For example, they may provide more or better quality food, or allow farmers to feed more people.

ISSUES SURROUNDING SELECTIVE BREEDING

PONTEFRACT

- Because of **selective breeding**, future generations of selectively bred plants and animals will all share very similar **genes** which will reduce **variation**.
- **Genes** and their different **alleles** within a population are known as its gene pool.
- Inbreeding can lead to a reduced **gene** pool, making it more difficult to produce new varieties in the future.
- This also makes organisms prone to certain diseases or inherited defects.

BENEFITS OF SELECTIVE BREEDING

PONTEFRACT

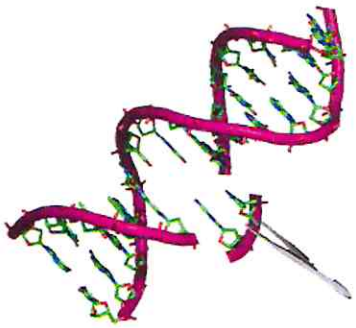
- New varieties may be economically important, by producing more or better quality food.
- Animals can be selected that cannot cause harm, for example cattle without horns.

RISKS OF SELECTIVE BREEDING

- Reduced **genetic** variation can lead to attack by specific insects or disease, which could be extremely destructive.
- Rare disease **genes** can be unknowingly selected as part of a positive trait, leading to problems with specific organisms, e.g. a high percentage of Dalmatian dogs are deaf.
- Can create physical problems in specific organisms, e.g. large dogs can have faulty hips due to not being formed correctly.

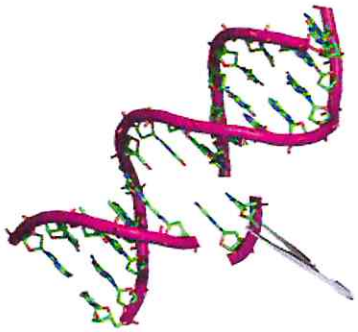
Lesson 11: GENETIC ENGINEERING

- What is **genetic engineering**?
- **Genetic engineering** is also called **genetic modification** or **GM**.
- It involves modifying the **genome** of an **organism** by introducing a **gene** from another **organism** to result in a desired **characteristic**.
- What is the **genome**?
- Entire **genetic** material in an **organism**.



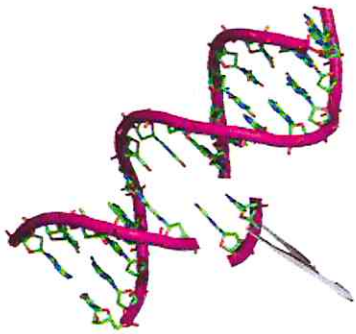
REHEARSAL

- What is **genetic engineering**?
- Taking a **gene** from one **organism** and inserting into another **organism**.
- What is the **genome**?
- Entire **genetic** material in an **organism**.



GENETIC ENGINEERING

- What are the stages of **genetic engineering**?
  1. Selection of the desired **characteristic**.
  2. The **gene** responsible for the **characteristic** is 'cut out' of the **chromosome** using **enzymes**.
  3. The gene is transferred and inserted into another **organism**.
  4. At an early stage of development.
- Plant crops have been **genetically engineered** to be disease resistant or to produce bigger fruits.
- Crops that have been modified in these ways are called **genetically modified** crops.



ADVANTAGES OF GENETICALLY MODIFIED CROPS

- Current **genetically modified** crops include those that are resistant to insect attack.
- They can also be herbicide resistant.
- Both of these features mean they have increased **yields**.
- Herbicide resistant crops allow them to tolerate the herbicide, but the weeds are killed by it, thus overall less herbicide is needed.

CONCERNS REGARDING GENETICALLY MODIFIED CROPS

- Concerns about **GM** crops include the effect on populations of wild flowers and insects.
- Some people feel the effects of eating **GM** crops on human health have not been fully explored.

GOLDEN RICE

- Scientists have added a gene to wild rice that makes it produce **beta carotene**.
- This changes the colour of the wild rice to a golden colour.
- Beta carotene is needed by humans in order to make vitamin A - which is essential for good vision.
- The advantage of golden rice is that it can be used in areas where vitamin A deficiency is common, so it can help prevent blindness.

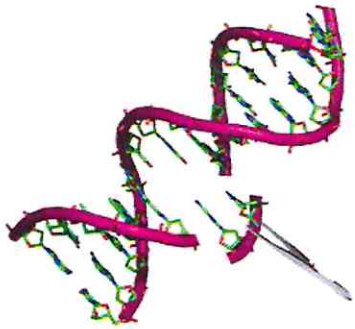
ETHICAL ISSUES WITH GENETIC MODIFICATION

- There are ethical issues involved in **genetic modification**, as well as concerns about the possible health risks of **genetically modified** food.
- For example, a **GM** food might contain a substance that causes an allergic reaction in some people, or higher levels of a toxin naturally found in the food.
- Others think it is ethically wrong to create new life forms, or to move **genes** between different species.

CURRENT USES OF GENETIC ENGINEERING

PONTEFRACT

- What is diabetes?
- Diabetes is a disorder in which the body's blood glucose levels remain too low or too high.
- How do you treat diabetes?
- It can be treated by injecting **insulin**.
- The extra **insulin** allows the glucose to be taken up by the liver and other tissues, which results in cells receiving the glucose they need, and blood glucose levels stay normal.
- Bacterial cells have been **genetically modified** to produce substances such as human **insulin**.



BENEFITS OF GENETIC ENGINEERING

PONTEFRACT

- There are many benefits to using **genetic engineering**.
- It is used in agriculture to do things such as, improve the **yields** of important economic crops, and provide insect or pest resistance.
- It is also used in the medical field to create **insulin**, which can be used for treating diabetes.
- But, as with most new technology, it also carries potential risks.

Lesson 12: FOSSILS

PONTEFRACT

- What is a **fossil**?
- A **fossil** is the preserved remains of a dead **organism** from millions of years ago.
- Where are **fossils** found?
- **Fossils** are found in rocks.

FOSSILS

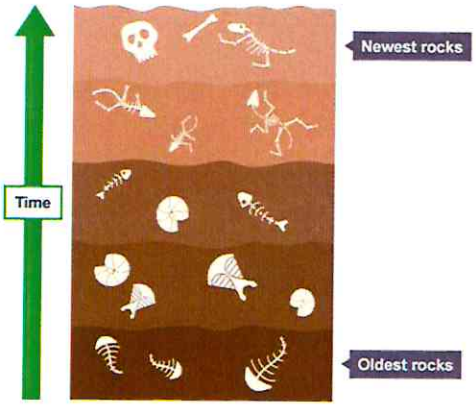
PONTEFRACT

- How are **fossils** formed?
- From hard body parts, such as **bones** and shells, which do not **decay** easily or are replaced by **minerals** as they **decay.**
- From parts of **organisms** that have not decayed because one or more of the conditions needed for **decay** are absent. For example, dead animals and plants can be preserved in amber, peat bogs, tar pits, or in ice.
- From preserved traces of organisms, such as footprints, burrows and rootlet traces - these become covered by layers of **sediment**, which eventually become rock.

THE FOSSIL RECORD

PONTEFRACT

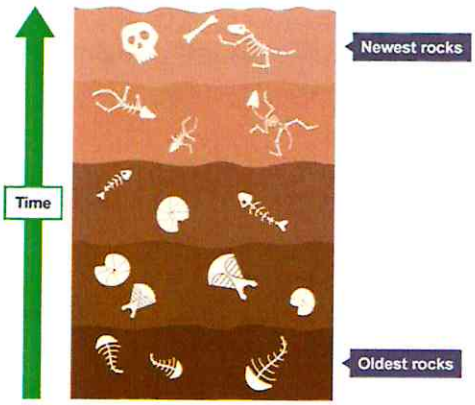
- **Fossil** remains have been found in rocks of all ages.
- **Fossils** of the simplest **organisms** are found in the oldest rocks, and fossils of more complex **organisms** in the newest rocks.
- This supports **Darwin's theory of evolution**, which states that simple life forms gradually evolved into more complex ones.



THE FOSSIL RECORD

PONTEFRACT

- Evidence for early forms of life comes from **fossils**.
- By studying **fossils**, scientists can learn how much (or how little) **organisms** have changed as life developed on Earth.
- Why is there little **evidence** of very early life on Earth?
- Many early forms of life were soft-bodied, which means that they have left few traces behind.
- What traces there were have been mainly destroyed by geological activity.



Lesson 13: EXTINCTION

PONTEFRACT

- What is **extinction**?
- **Extinction** occurs when there are no remaining individuals of a **species** alive.

- What is a **species**?
- A group of organisms that can interbreed to produce fertile offspring.

EXTINCTION

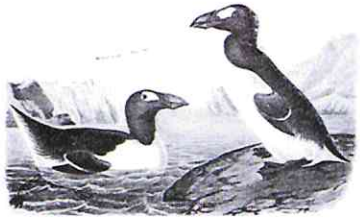
PONTEFRACT

- Why do animals become **extinct**?
- If they are not well adapted well to their **environment** they are less likely to **survive** and reproduce than those that are well adapted.
- The animals that have not adapted to their **environment** may become **extinct**.
- **Extinction** has a role in **evolution** as some **species** disappear.
- Others **survive** and continue to evolve.

EXTINCTION

- Can you name some animals that are **extinct**?

- Dinosaur
- Dodo
- Woolly mammoth
- Great Auk
- Tasmanian Tiger
- West African Black Rhino



THE STORY OF THE DODO

- The dodo was a large flightless bird that lived on the island of Mauritius. It nested on the ground in forests, producing one egg at a time.
- What reasons could have caused the dodo to become **extinct**?

When human settlers arrived on the island in the mid-1600s, they brought animals such as rats and dogs to the island, which ate the dodos' eggs.

The settlers chopped down the forests in which the dodos lived, and may have even hunted the dodo for food.

REASONS FOR EXTINCTION

PONTEFRACT

- What reasons could cause a **species** to become **extinct**?
  - New **diseases.**
  - New **predators.**
  - New, more successful **competitors.**
  - Changes to the **environment** over geological time, such as climate change.
  - A single catastrophic event, such as a massive volcanic eruption or a collision between an asteroid and the Earth.

THE FOSSIL RECORD AND EXTINCTION

PONTEFRACT

- What does the fossil record show us about **extinction**?
- The fossil record shows that many species have become **extinct** since life on Earth began.
- **Extinction** is still happening and often, it is due to human activities.
- What do humans compete with other living organisms for?
- Humans compete with other living organisms for space, food and water - humans are very successful **predators**.

Lesson 14: DARWIN'S THEORY OF NATURAL SELECTION

PONTEFRACT

There is **variation** due to differences in genes.

This can be as a result of a random **mutation**

Those individuals with **characteristics** most suited to the environment **survive.**

They **survive**, reproduce and pass on their **genes** to their offspring.

EVIDENCE FOR EVOLUTION - FOSSILS

PONTEFRACT

- What provides the evidence for **evolution**?

- Fossils.
- Antibiotic resistant bacteria.
- Understanding that characteristics are passed on to offspring in genes. We now know the mechanism of inheritance (DNA).

EVIDENCE FOR EVOLUTION – ANTIBIOTIC RESISTANT BACTERIA

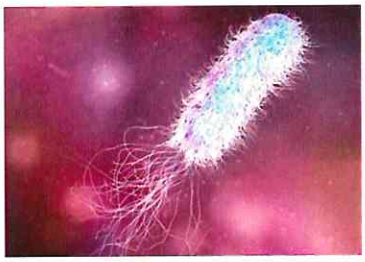
PONTEFRACT

- What is a bacteria?
- A pathogen.
- What is a pathogen?
- A microorganism that causes disease.
- What is an antibiotic?
- A drug that kills bacteria.
- Name an antibiotic.
- Penicillin

EVIDENCE FOR EVOLUTION – ANTIBIOTIC RESISTANT BACTERIA

PONTEFRACT

- Why can **bacteria** evolve so quickly?
- **Bacteria** can evolve quickly because they reproduce at a fast rate.
- Mutations of **bacteria** produce new strains.
- Some bacteria might become **resistant** to certain **antibiotics**
- What would this mean?
- The **bacteria** would not be destroyed by the antibiotic.
- The **evolution** of the **bacteria** is an example of **natural selection**.

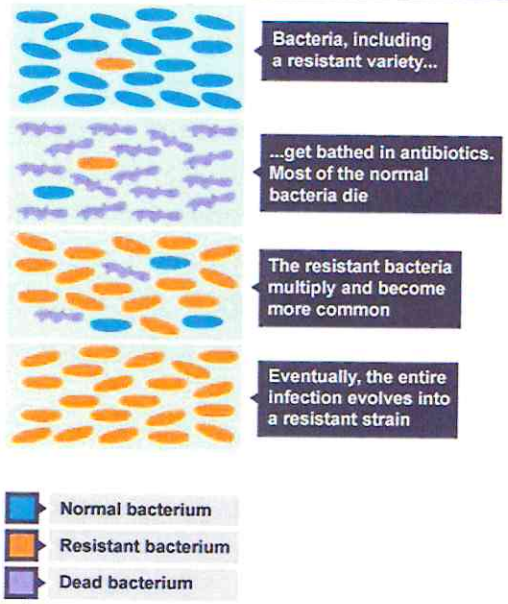


ANTIBIOTIC RESISTANT BACTERIA - DEVELOPMENT

PONTEFRACT

The main steps in the development of resistance are:

1. Random **mutations** occur in the genes of individual **bacterial** cells.
2. Some **mutations** protect the **bacterial** cell from the effects of the **antibiotic**.
3. **Bacteria** without the **mutation** die or cannot reproduce when the **antibiotic** is present.
4. **Resistant bacteria** can reproduce with less **competition** from normal **bacterial** strains.



MRSA

PONTEFRACT

- What is MRSA?
- MRSA is methicillin-resistant *staphylococcus aureus.*

- Methicillin is an **antibiotic**.
- MRSA is very dangerous because it is **resistant** to most **antibiotics**.

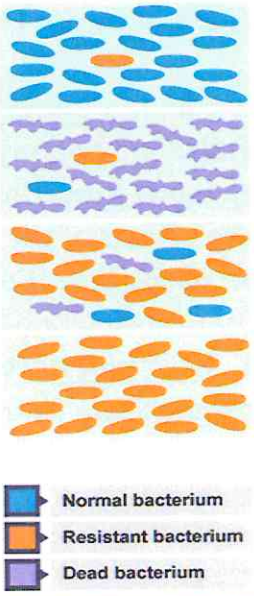
- Why has the number of **resistant** strains increased?
- The number of **resistant** strains has increased due to the overuse of **antibiotics**.
- This has resulted in more infections that are difficult to control.

PREVENTING ANTIBIOTIC RESISTANT BACTERIA

PONTEFRACT

- How can we prevent the development of **antibiotic resistant** strains of **bacteria**?
- Doctors should not prescribe **antibiotics** inappropriately, such as for the treatment of non-serious or viral infections.
- Patients should always complete the full course of **antibiotics** to ensure all bacteria are killed and none survive to **mutate** and form resistant strains.
- Agricultural use of **antibiotics** should be restricted.

- The development of new **antibiotics** is costly and slow. It is unlikely to keep up with the emergence of new **resistant** strains.



Lesson 15: LINNAEAN SYSTEM OF CLASSIFICATION

PONTEFRACT

- Living organisms are classified into groups depending on their structure and characteristics.
- This system was developed in the eighteenth century by Carl **Linnaeus**.
- The classification of species allows the subdivision of living organisms into smaller and more specialised groups.

KINGDOMS

- The first division of living things in the classification system is to put them into one of five **kingdoms**.

- The five **kingdoms** are:

- animals (all multicellular animals)
- plants (all green plants)
- fungi (moulds, mushrooms, yeast)
- protists (Amoeba, Chlorella and Plasmodium)
- prokaryotes (bacteria, blue-green algae)

FURTHER DIVISIONS

- Living things can then be ranked according to:
  - **kingdom**
  - **phylum**
  - **class**
  - **order**
  - **family**
  - **genus**
  - **species**

BINOMIAL SYSTEM

PONTEFRACT

- Organisms are named by the binomial system of genus and species.

GENUS SPECIES

Panthera leo (lion)

Panthera tigris (tiger)

BINOMIAL SYSTEM

PONTEFRACT

- The **binomial** system of naming species uses Latin words.
- Each name has two parts, the **genus** and the **species**.
- For example, human beings belong to the **genus** *Homo*, and our **species** is sapiens - so the scientific name is *Homo sapiens*.

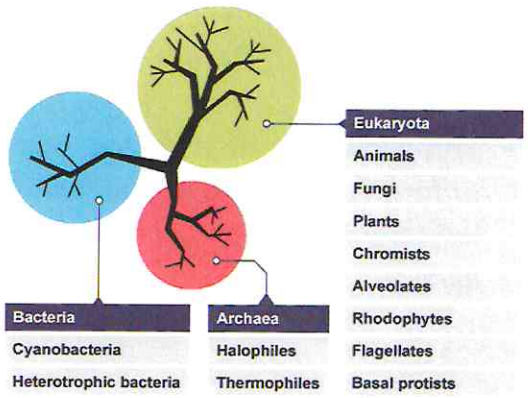
The European robin is *Erithacus rubecula*.

TECHNOLOGY

- Originally **Linnaeus's** system relied purely on human judgement to compare the characteristics of various organisms.
- The development of microscopes allowed cells to be examined in far more detail.
- Organelles within the individual cells could be distinguished and this allowed a more scientific approach of classification.

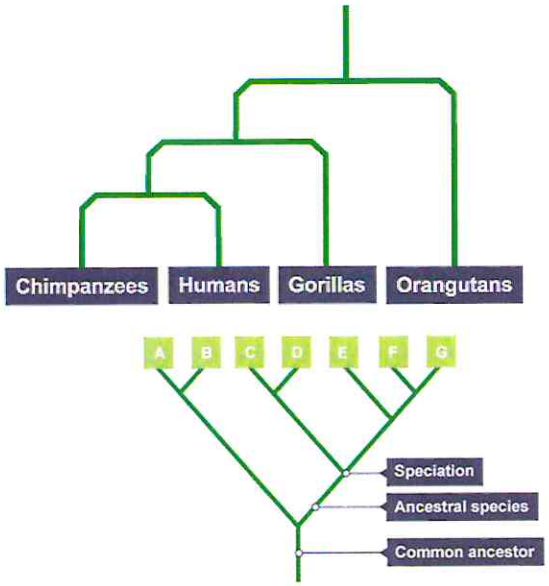
THREE DOMAIN SYSTEM

- Due to evidence available from chemical analysis there is now a 'three **domain** system' developed by Carl **Woese**.
- In this system organisms are divided into:
  - archaea (primitive bacteria usually living in extreme environments)
  - bacteria (true bacteria)
  - eukaryota (which includes protists, fungi, plants and animals)



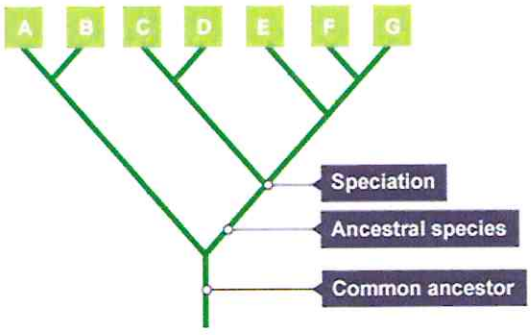
EVOLUTIONARY TREES

- **Evolutionary trees** are a method used by scientists to represent the relationships between a set of organisms.
- The tips of the tree often represent different species and where two branches join, this represents a common ancestor for those two species.
- They can be created from current data such as DNA analysis and existing fossil data.



EVOLUTIONARY TREES

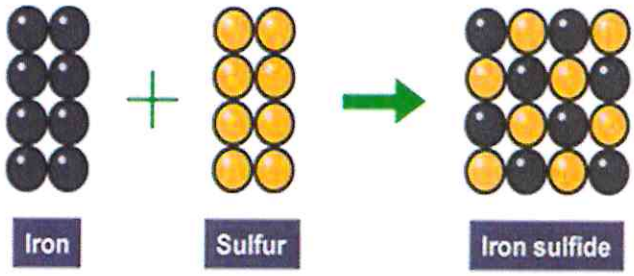
- **Evolutionary trees** can be created using DNA sequences of different species.
- This allows scientists to examine the differences at a DNA level, which may have led to evolutionary splits millions of years ago.



Lesson 16: Conservation of mass and balancing equations

Conservation of mass

- The picture shows how the atoms rearrange in the reaction between iron and sulphur.
- All atoms have mass.
- Atoms cannot be created or destroyed, only rearranged.



- The law of **conservation of mass** states:

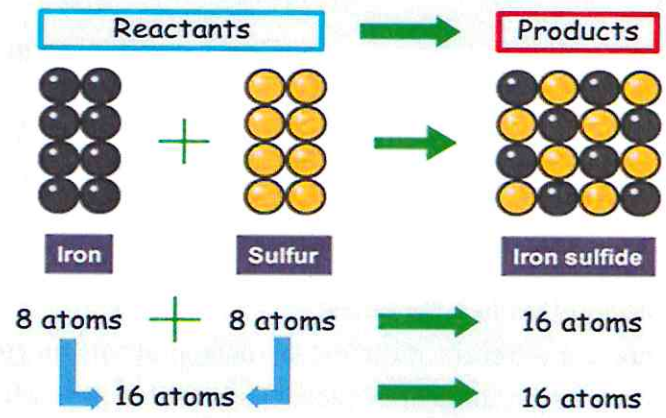
"The total mass of **products** at the end of the reaction is equal to the total mass of the **reactants** at the beginning.

Mass is conserved".

Conservation of mass and balancing equations

Conservation of mass

- The picture shows **conservation of mass** in a reaction between iron and sulphur to form iron sulphide.
- In a reaction the total number of **reactant** atoms has to be the same as the total number of **product** atoms.
- No mass has been created or destroyed in a chemical reaction.
- We need chemical reaction equations to also display this. We need them to be balanced.



PONTEFRACT

Understanding numbers in chemical equations

- The equation below shows a typically balanced chemical equation.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

- The small numbers which are subscripts tell us the number of atoms of a certain element in this particular compound.
- There are 4 hydrogen atoms in this compound.

- The large numbers tell us that in this chemical equation there are two water molecules made.
- We multiply the rest of the chemical compound formula by this number.
- This means there are 4 hydrogen atoms and 2 oxygen atoms in this compound.

PONTEFRACT

Unbalanced chemical equations

- The equation below shows an **unbalanced** chemical equation for the reaction of hydrogen and oxygen.

$$H_2 + O_2 \rightarrow H_2O$$

- You can simply tell if an equation is balanced by counting the number of each atom on each side of the equation:

$$H_2 + O_2 \rightarrow H_2O$$

Reactants	Products
2 hydrogen atoms	2 hydrogen atoms
1 oxygen atom	2 oxygen atoms

- This equation is unbalanced.
- There are different numbers of oxygen atoms on **reactants** side to the **products** side.
- This equation does not follow the law of conservation of mass.

What are balanced equations?

- The equation below shows a **balanced** chemical equation for the reaction of nitrogen and hydrogen.

$$3H_2 + N_2 \rightarrow 2NH_3$$

Reactants	Products
2 Nitrogen atoms	2 Nitrogen atoms
6 Hydrogen atoms	6 Hydrogen atoms

- This chemical equation is balanced.
- The number of atoms of each element on the reactant side are the same as those on the product side.
- This equation does follow the law of conservation of mass.

Rules for balancing chemical equations

- Below is a typically unbalanced chemical equation

$$Al + O_2 \rightarrow Al_2O_3$$

Rule 1
You can only add big numbers in front of the whole compound or element.

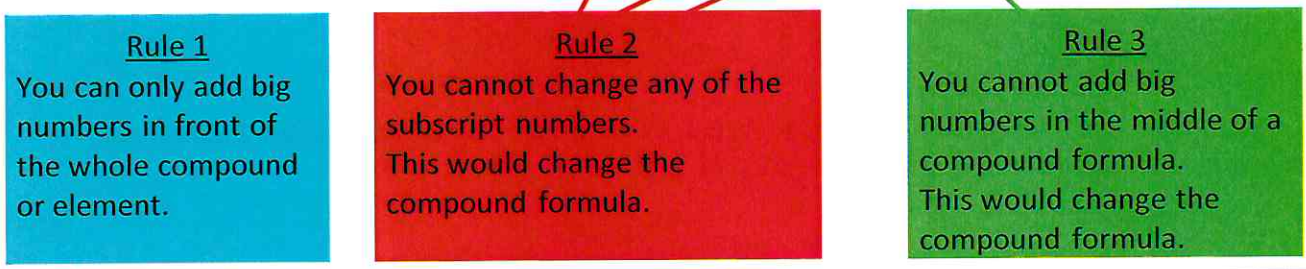
Rule 2
You cannot change any of the subscript numbers.
This would change the compound formula.

PONTEFRACT

Rules for balancing chemical equations

- Below is a typically unbalanced chemical equation

$$Al + O_2 \rightarrow Al_2O_3$$



Rule 1
You can only add big numbers in front of the whole compound or element.

Rule 2
You cannot change any of the subscript numbers.
This would change the compound formula.

Rule 3
You cannot add big numbers in the middle of a compound formula.
This would change the compound formula.

PONTEFRACT

How to balance a chemical equation

- Below is a typically unbalanced chemical equation

$$Al + O_2 \rightarrow Al_2O_3$$

To balance a chemical equation you carry out the following steps

1. List the elements present on both sides of the equation.
2. Count the number of each type of element present on each side of the equation.
3. Add large numbers in front of parts of the equation until the numbers of each element on either side equal each other.
4. Remember adding a large number in front of a compound will change the number of atoms of each of the element in that compound.

PONTEFRACT

How to balance a chemical equation step 1 list the elements

- Below is a typically unbalanced chemical equation

$$Al + O_2 \rightarrow Al_2O_3$$

Reactant elements present	Product element present
Al	Al
O	O

PONTEFRACT

How to balance a chemical equation step 2 count the atoms present of each element

- Below is a typically unbalanced chemical equation

$$Al + O_2 \rightarrow Al_2O_3$$

Reactant elements present	Product element present
Al = 1 (unbalanced)	Al = 2 (unbalanced)
O = 2 (unbalanced)	O = 3 (unbalanced)

PONTEFRACT

How to balance a chemical equation step 3 add large numbers to balance the atoms

- Below is a typically unbalanced chemical equation

$$Al + 3O_2 \rightarrow 2Al_2O_3$$

Reactant elements present	Product element present
Al = 1 (unbalanced)	Al = 2 x 2 = 4 (unbalanced)
O = 2 x 3 = 6 (balanced)	O = 3 x 2 = 6 (balanced)

PONTEFRACT

How to balance a chemical equation step 3 add large numbers to balance the atoms

- Below is a typically unbalanced chemical equation

$$4Al + 3O_2 \rightarrow 2Al_2O_3$$

Reactant elements present	Product element present
Al = 1 x 4 = 4 (balanced)	Al = 2 x 2 = 4 (balanced)
O = 2 x 3 = 6 (balanced)	O = 3 x 2 = 6 (balanced)

How to balance a chemical equation example

- Below is a typically unbalanced chemical equation

$$N_2 + 3H_2 \rightarrow 2NH_3$$

Reactant elements present	Product element present
N = 2 (balanced)	N = 1 x 2 = 2 (balanced)
H = 2 x 3 = 6 (balanced)	H = 3 x 2 = 6 (balanced)

Lesson 17:

Relative formula mass

Chemical formulas

- The picture shows both the **chemical formula** and the chemical structure of carbon dioxide.

CO_2

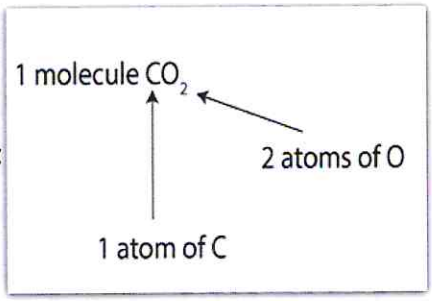
- **Chemical formulas** are used by scientists to show the number and type of atoms present in a substance.
- This is done using chemical symbols and numbers.
- Formulas make it easier for scientists to understand different substances around us and write chemical equations which contain many different reactants.

PONTEFRACT

Relative formula mass

Interpreting chemical formulas

- The picture shows the **chemical formula** for carbon dioxide interpreted:
- Symbols with no small number after it means there is only 1 atom:
  CaO - means 1 calcium atom 1 oxygen atom.
- Small numbers after a symbol multiply the element in front of them:
  O_2 - means 2 oxygen atoms.
- Small numbers multiply whatever is in a bracket by that number:
  $(OH)_2$ means 2 oxygen and 2 hydrogen atoms.
- Big numbers in front of formulas multiply everything after it:
  $2H_2O$ means 4 hydrogen atoms and 2 oxygen atoms.



PONTEFRACT

Relative formula mass

Interpreting chemical formulas examples

- The picture shows the **chemical formula** for water.
- Water – H_20 – the formula shows that water contains
  - 2 Elements in total (Hydrogen and oxygen)
  - 3 atoms in total
  - 2 hydrogen atoms and 1 oxygen atom

H_2O

Relative formula mass

Interpreting chemical formulas examples

- The picture shows the **chemical formula** for sulphuric acid:

H_2SO_4

- Sulphuric acid – H_2SO_4 – the formula shows that sulphuric acid contains:
  - 3 elements in total (hydrogen, sulphur and oxygen)
  - 7 atoms in total
  - 2 hydrogen 1 sulphur and 4 oxygen.

Relative formula mass

What is relative formula mass?

- The picture shows a molecule of carbon dioxide:
- The **relative formula mass** of a substance is the sum of the **relative atomic masses** of all the atoms in the numbers shown in the **chemical formula**.
- **Relative formula mass** has the symbol, M_r.
- Example: What is the relative formula mass of carbon dioxide?

  Relative atomic mass of carbon = 12

  Relative atomic mass of Oxygen = 16

  CO_2

  Relative formula mass = 12 + 16 + 16 = 44

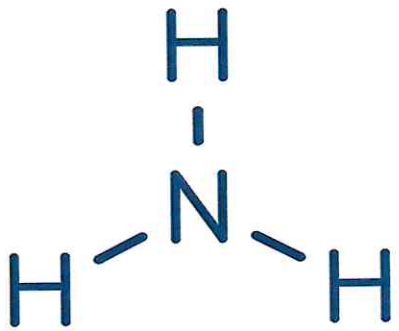
O=C=O

CO_2

Relative formula mass

How do you calculate formula mass?

- The diagram shows the structure of Ammonia (NH_3).



Steps to calculate formula mass of a substance:

1) Work out the number of each type of atom present in a formula.

   1 X N 3 x H

1) Find the relative atomic mass (A_R)of each type of atom.

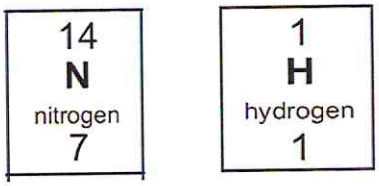
   N = 14 H = 1

1) Multiply the atomic mass by the number of atoms present

   N = 14 X 1 = 14 H = 3 X 1 = 3

1) Add the totals together

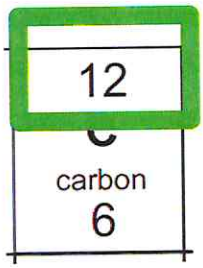
   14 + 3 = 17

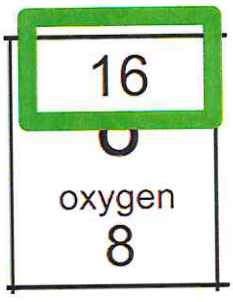


Relative formula mass

Calculating formula mass examples

- The diagrams show symbols for oxygen and carbon with **relative atomic mass** identified:





Relative formula mass of carbon dioxide CO_2

1) Work out the number of each type of atom present in a formula.

   1 X C 2 x O

1) Find the relative atomic mass (A_R)of each type of atom.

   C = 12 O = 16

1) Multiply the atomic mass by the number of atoms present

   C = 12 X 1 = 12 O = 2 X 16 = 32

1) Add the totals together

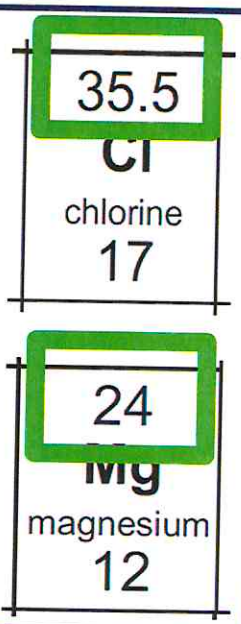
   12 + 32 = 44

Relative formula mass

PONTEFRACT

Calculating formula mass examples

- The diagrams show symbols for magnesium and chlorine with **relative atomic mass** identified:



Relative formula mass of magnesium chloride $MgCl_2$

1) Work out the number of each type of atom present in a formula.

1 X Mg 2 x Cl

1) Find the relative atomic mass (A_R)of each type of atom.

Mg = 24 Cl = 35.5

1) Multiply the atomic mass by the number of atoms present

Mg = 24 X 1 = 24 Cl = 2 X 35.5 = 71

1) Add the totals together

24 + 71 = 95

Relative formula mass

PONTEFRACT

Relative formula masses in balanced equations

- The equation shows the reaction between carbon and oxygen.
- In a balanced equation the sum of the **relative formula masses** of reactants will always equal the sum of the **relative formula masses** of products.
- This shows conservation of mass in reactions as mass is not created nor destroyed. It stays the same before and after the reaction.

Carbon + Oxygen → Carbon Dioxide

$C + O_2 \rightarrow CO_2$

$C + O{=}O \rightarrow O{=}C{=}O$

Relative formula mass

Relative formula masses in balanced equations

- The equation shows conservation of mass in reaction of carbon and oxygen.

$$C + O_2 \rightarrow CO_2$$

C	O_2	CO_2
Relative Atomic Mass 12	Relative Formula Mass 32	Relative Formula Mass 44

Total **relative formula masses**
= 32 + 12
= 44

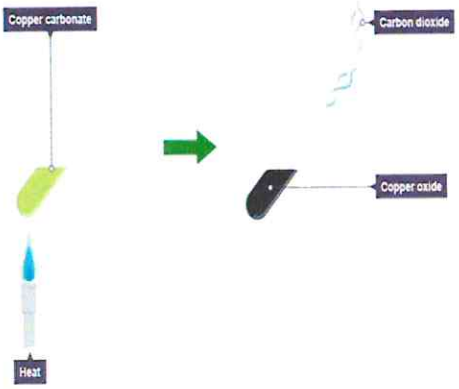
Total **relative formula masses**
= 44

Lesson 18:

Mass changes in chemical reactions

Reactions where a gas is produced

- The image shows the thermal decomposition of copper carbonate.



- The equation to represent the reaction is shown below.

$$CuCO_3 \rightarrow CuO + CO_2$$

- In this reaction a **gas** escapes into the air/ surroundings,
- The total mass will appear to have decreased.
- This is because **gas** has mass.

Mass changes in chemical reactions

Reactions where a gas is produced

- The equation below represents the thermal decomposition of copper carbonate.

$$CuCO_3 \rightarrow CuO + CO_2$$

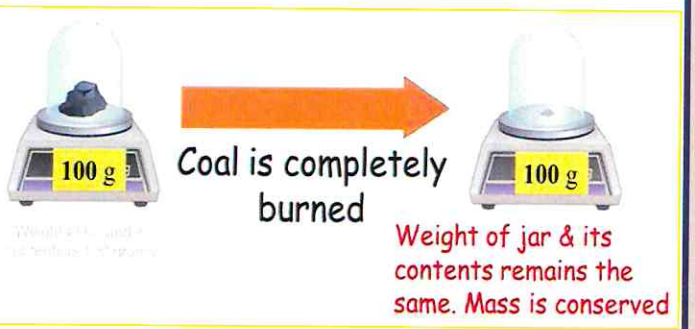
Masses	100g	65g	35g

- In a reaction where a **gas** escapes into the air/ surroundings , the total measured mass will look as if it has decreased.
- This is because **gas** has mass.

Mass changes in chemical reactions

Reactions in closed systems

- The picture shows a reaction in a closed system.
- No substances can enter or leave a closed system, such as a stoppered flask or a reaction with a beaker surrounding it.
- In a closed system the **mass** at the beginning and end of the reaction will always stay the same even if a **gas** is produced.
- This proves the **law of conservation of mass**.

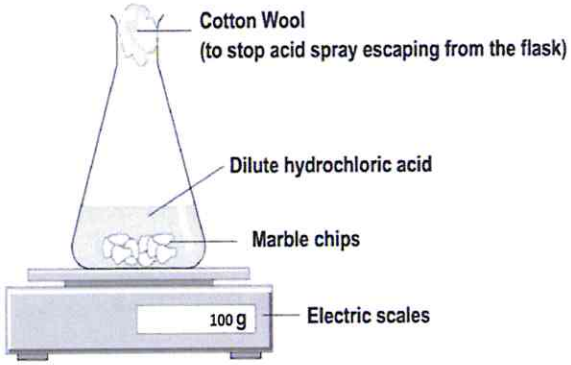


Mass changes in chemical reactions

Demonstration – Conservation of mass when a gas is produced

- The image shows the apparatus used to monitor the changes in mass of the reaction between hydrochloric acid and limestone chips in an open system.

- Before the reaction starts, measure the mass of of the flask, acid and limestone chips.
- Add these together to determine the total mass at the start of the reaction.
- As the reaction happens the **mass** on the electronic balance decrease as carbon dioxide **gas** is produced and escapes into the atmosphere.



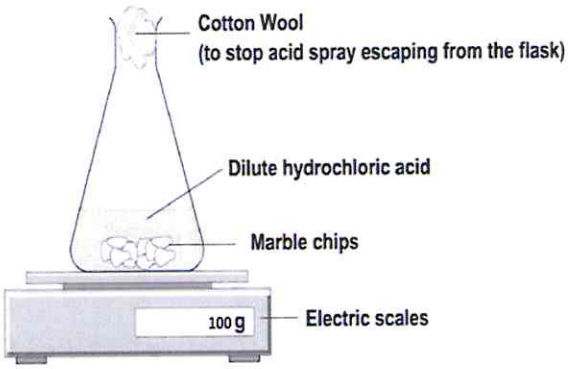
Mass changes in chemical reactions

Demonstration – Conservation of mass when a gas is produced

- The results table below shows typical results obtained from this reaction.

Before the reaction	
Beaker	50g
Limestone chips + acid + beaker	165g
Limestone chips + acid	165 - 50 = 115g
After the reaction	
Limestone chips + acid + beaker	122g
Limestone chips + acid	122 - 50 = 72g

- Ast the results show, the mass "appears" to have decreased.



Mass changes in chemical reactions

PONTEFRACT

Demonstration – Conservation of mass when a gas is produced

- The equation below represents the reaction between limestone chips and acid.

$$CaCO_3 + HCl \rightarrow CaCl_2 + CO_2$$

Masses	20g	95g	72g	43g
Total Masses	20 + 95 = 115g		72 + 43 = 115g	

- The "appeared" mass lost can be explained by the carbon dioxide gas that escapes into the surroundings.
- This is because **gas** has mass but cannot be measured using a balance.

Mass changes in chemical reactions

PONTEFRACT

Reactions where a gas is added

- The picture shows magnesium burning in air.

- The equation to represent the reaction is shown below.

$$2Mg + O_2 \rightarrow 2MgO$$

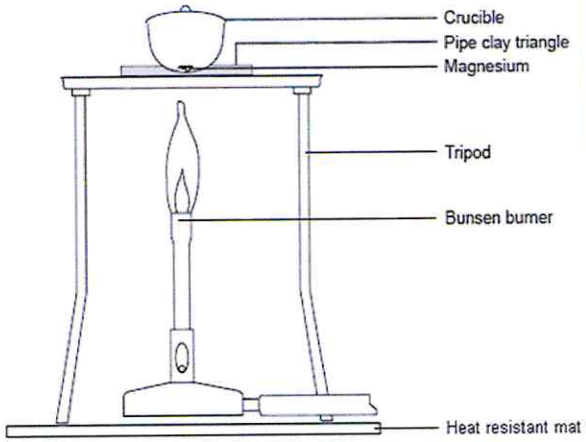
- In this reaction a **gas** bonds to the magnesium from air/ surroundings,
- The total mass will appear to have increased.
- This is because **gas** has mass.

Mass changes in chemical reactions

Demonstration – Conservation of mass when a gas is added

- The image shows the apparatus used to monitor the changes in mass of the reaction between magnesium and air in an open system.

1. Measure the mass of an empty crucible
2. Measure mass of crucible and magnesium.
3. Calculate the mass of magnesium before.
4. Heat with crucible lid slightly open.
5. Wait for magnesium to turn white (not glowing).
6. Measure mass of crucible with magnesium in it.
7. Calculate the mass of magnesium after.



Mass changes in chemical reactions

Demonstration – Conservation of mass when a gas is added

- The equation below represents the reaction between magnesium and oxygen.

$$2Mg + O_2 \rightarrow MgO$$

Masses	1.2g	0.7g	1.9g
Total Masses	1.2 + 0.7 = 1.9g		1.9g

- The "appeared" mass gain can be explained by the oxygen gas that bonds to the magnesium from the surrounding air.
- This is because **gas** has mass but cannot be measured using a balance.

Mass changes in chemical reactions

PONTEFRACT

State Symbols

- The table below shows the 4 state symbols which are used in chemical reactions equations.

Symbol	Meaning	Example
(g)	Gas	Hydrogen $H_{2(g)}$
(l)	Liquid	Water $H_2O_{(l)}$
(s)	Solid	Sodium $Na_{(s)}$
(aq)	Aqueous (Solid dissolved in water)	Sodium Hydroxide $NaOH_{(aq)}$

- By using the state symbols in a chemical reaction equation we are able to offer an explanation as to why mass "appears" to increase or decrease.

Mass changes in chemical reactions

PONTEFRACT

Using state symbols to explain mass changes

- Below are the chemical symbol equations representing the two reactions we have just carried out. They have the state symbols of the chemicals added.

$$CaCO_{3(s)} + HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2(g)}$$

Mass "appears" to decrease

- In this reaction equation. One of the products is a gas.
- We can see it is a gas because is has the state symbol (g).
- This explains why the mass appears to have decreased because the gas escapes into the surroundings and cannot be measured using a balance.

$$2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$$

Mass "appears" to increase

- In this reaction equation. One of the reactants is a gas.
- We can see it is a gas because is has the state symbol (g).
- This explains why the mass appears to have increased because the gas bonded to the reactant from the surroundings and cannot be measured using a balance.

To attempt to explain changes in mass. LOOK AT THE STATE SYMBOLS!!!

Lesson 19:

Chemical measurements

Resolution

- The picture shows a stopwatch with a **resolution** of 0.01 seconds.
- The **resolution** of a measuring instrument is the smallest change in a quantity that gives a change in the reading that can be seen.
- A thermometer with a mark at every 1.0°C has a **resolution** of 1.0°C. It has a higher **resolution** than a thermometer with a mark at every 2.0°C.
- For a digital measuring instrument the **resolution** is the last unit shown on the display. For example the r**esolution** of a stopwatch with be either 1 second, 0,.1 seconds or 0.01 seconds

Chemical measurements

Range

- The table shows a set of **experimental measurements**/ results.
- **Range** of data is the difference between the largest and smallest results.
- From the table the **range** of length of pendulum is from 10cm to 50cm (40cm)
- From the table the **range** of time taken is from 0.63 secs to 1.42 secs (0.79secs)

Length of pendulum/cm	Time taken to complete 1 swing/s
10	0.63
20	0.90
30	1.10
40	1.27
50	1.42

Rehearsal

PONTEFRACT

1) What is the **resolution** of measuring equipment?

The resolution of a measuring instrument is the smallest change in a quantity that gives a change in the reading that can be seen.

2) What is the **range** of experimental data?

Range of data is the difference between the largest and smallest results.

3) What is the **range** of the following results: 3, 5, 4, 7

From smallest to largest = 3 to 7 = 4

PONTEFRACT

Chemical measurements

Estimating uncertainty from experimental measurements

- The table shows a set of **experimental measurements**.
- **Uncertainty** is simply how much you can trust **experimental measurements**.
- For a set of repeat **experimental measurements**, the **uncertainty** is ± half the **range**. This means that the value is the mean value ± half the **range**.

- Example; What is the **uncertainty** of the **experimental measurements** in the table?

Mean = 24 +24.5 + 23.5 + 25 + 23 / 5 = 24 Range = 23 – 25 = 2

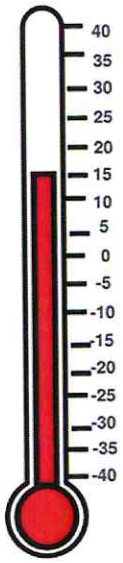
So **uncertainty** (mean plus/ minus half the range) = 24 ± 1

Test number	1	2	3	4	5
Volume	24.0	24.5	23.5	25.0	23.0

Chemical measurements

Estimating uncertainty from measuring equipment

- The picture shows a thermometer with a reading of 15 degrees with a mark every 5 degrees. (it's interval)
- The **uncertainty** of measuring equipment is ± half the interval. The internal is the smallest scale division on the measuring equipment.
- The interval of the thermometer is 5 degrees
- Example: the **uncertainty** of the thermometer is ± 2.5 degrees. As the reading is 15 degrees the **uncertainty** is 15 degrees ± 2.5
- That means the actual reading could be anywhere between 12.5 and 17.5 degrees.



Rehearsal

1) What is **uncertainty** of data?

How much you can trust the data (the lower the uncertainty the more you can trust the data)

2) Describe what you need to do the calculate the **uncertainty** of experiment results?

Calculate the mean and the range of the results and then take the mean ± half the range.

3) Calculate the **uncertainty** of the following **experimental measurements**: 4, 5, 5, 6

mean = 4+5+5+6/ 4 = 20/4 = 5 range is from 4 to 6 = 2 uncertainty = mean ± half the range, so uncertainty = 5 ± 1

Lesson 20:

Concentrations of solutions

PONTEFRACT

- The picture shows a tube of Berocca, which is can be dissolved into water to form a vitamin based drink.
- The Berocca drink (tablet + water) is a called a **solution**.
- A **solution** is a mixture of a substance/ **solute** dissolved in a **solvent** (normally a liquid).
- We often WRONGLY use the term strength or diluted to describe the Berocca solution. The CORRECT term we should use is **concentration**.
- We can make the Berocca drink to our individual taste by changing it's **concentration** by either adding more or less water to the tablets when dissolving them.

Concentrations of solutions

PONTEFRACT

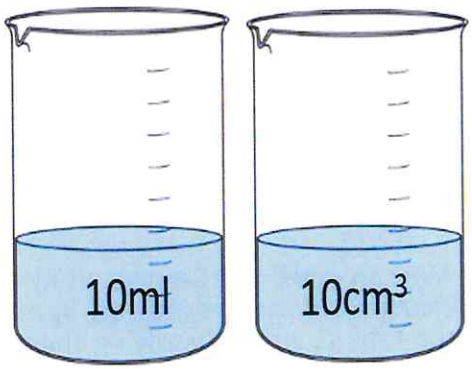
What is concentration?

- The picture shows a Berocca tablet dissolving in water to form a salt **solution**.
- All **solutions**, have a **concentration**. Many chemical reactions take place in **solutions**.
- **Concentration** is a measure of the number of particles per unit volume, and is not related to strength.
- **Concentration** of a **solution** can simply be defined as the mass in grams of **solute** dissolved in a dm^3 of a **solvent** (often water). Units are g/dm^3.
- The **solute** is the substance, which gets dissolved and the **solvent** is the liquid it is dissolved in.

Concentrations of solutions

Units of volume when calculating concentration

- Both of these beakers in the picture contain the same volume of water.
- In chemistry we measure liquids in cm^3 but 1ml is equal to $1cm^3$.
- When we calculate concentration, we calculate it in g/dm^3.



Essential conversions for concentration calculations

1 millitre = $1cm^3$

1 litre = 1000millitires

1 dm^3 = $1000cm^3$

Rehearsal

Convert the following volumes into dm^3

$20cm^3$ = $20 / 1000 = 0.02dm^3$

$2500cm^3$ = $2500 / 1000 = 2.5dm^3$

400ml = $400ml = 400cm^3$

$= 400 / 1000 = 0.4dm^3$

Essential conversions

1millitre = $1cm^3$

1 litre = 1000millitires

1 dm^3 = $1000cm^3$

Concentrations of solutions

PONTEFRACT

How can we change concentration ?

- The picture shows a fruit juice being diluted, by adding water to it.

- The **concentration** of a **solution** can be changed by either:

a) changing the amount of **solute** added to it

b) changing the amount of water added to it

Concentrations of solutions

PONTEFRACT

High and low concentrations of solutions

- The pictures shows representations of high and low **concentration solutions**:

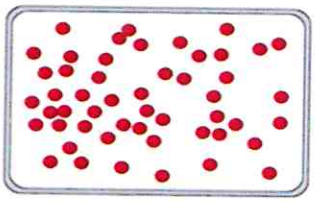
A high **concentration** of a **solution**

- will have lots of **solute** particles per volume of **solvent**.

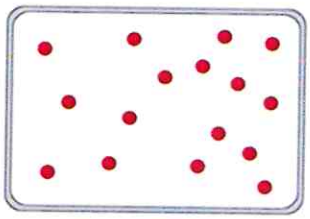
A low **concentration** of **solution**

- will have a small number of **solute** particles per volume of **solvent.**

The red particles represent solute particles



High concentration



Low concentration

Concentrations of solutions

How do we calculate concentration?

- The picture shows a Berocca tablet dissolving in a glass of water.
- In this situation there are two pieces of information we know about this solution.

1. The mass of the Berocca tablet that was dissolved.
2. The volume of water it was being dissolved into.

- We do not know the concentration of the solution.
- We need to calculate this using the information we do know.

Concentrations of solutions

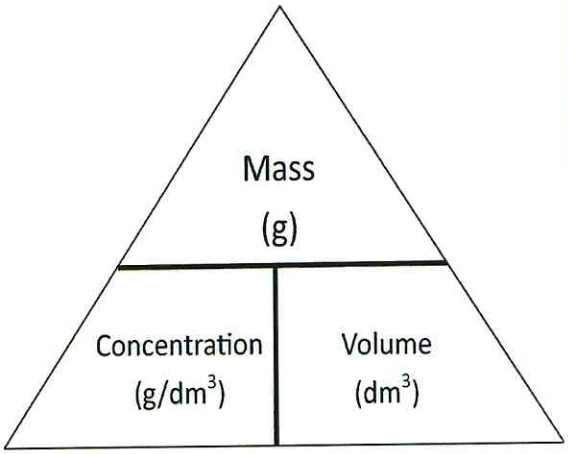
How do we calculate concentration when using mass?

- The picture shows the formula triangle we shows the relationship between:

  volume / concentration / and mass.

- We can use this formula triangle to calculate concentration, or any other information we need if we know the other two parts to it.

- Mass is measured in grams (g)
- Volume is measured in (dm^3)
- Concentration is measured in (g/dm^3)



Concentrations of solutions

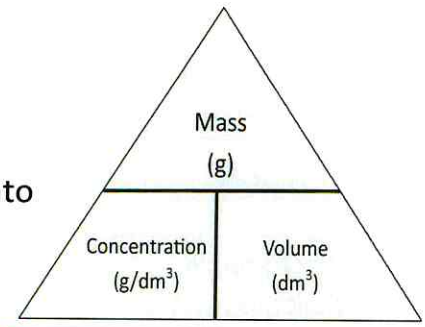
Calculating concentration examples

- Below shows a typical concentration calculation question.

> A company dissolves 50g of HCl in 10dm^3 of water.
> Calculate the **concentration** of the **solution** in g/ dm^3?

How to calculate concentrations:

1. Ensure volume is in dm^3.
2. If not convert to dm^3 (divide by 1000).
3. Take the relevant numbers from the question and put them into the formula triangle.
4. Calculate concentration using the formula triangle.



Lesson 21:

Using Earth's Resources & Sustainable Development

Earth's resources

- This is a picture of gold.
- Gold is **natural resource** which is extracted from the ground.
- Gold is used to make jewellery.
- Gold is one example of the Earth's useful **natural resources**.

Using Earth's Resources & Sustainable Development

PONTEFRACT

Earth's resources key definitions

Finite	Resources that can't be formed quickly enough to be considered replaceable.
Renewable	Resources that can be re-formed at a similar rate to, or faster than, we can use them.
Sustainable	Resources that are used or harvested in such a way that it is not depleted or permanently damaged.
Natural	Resources that form without input from humans, come from air, earth or sea.
Sustainable development	Development that meets the needs of the present, without compromising the needs of future generations.

Using Earth's Resources & Sustainable Development

PONTEFRACT

Earth's natural resources

- The picture shows some examples of the Earth's natural resources.
- A **natural resource** is one which forms without any human input.
- Humans use the Earth's **natural resources** for different purposes:
  - Fuels to provide warmth
  - Building materials for shelter such as timber
  - Food with the help of agriculture
  - Fuels for transport
  - Materials for clothing

Using Earth's Resources & Sustainable Development

Replacing Earth's natural resources

- The picture shows window frames made from uPVC plastic.
- Some **natural resources** have been replaced by man made products.
- Wooden window frames have been replaced by plastics as they last longer.
- Other examples of **natural resources** which have been replaced are:
  - Natural rubber in tyres
  - Cork in wine bottles.
- These have been replaced by man made polymers.

Using Earth's Resources & Sustainable Development

Renewable resources

- The picture shows timber.
- Timber is a **renewable resource**.
- Timber is a **renewable resource** because it can be reformed at a similar rate to the rate we use it.
- The trees can be replanted and only take a few years to regrow.
- Other examples include vegetable crops and **sustainably** caught fish.

Using Earth's Resources & Sustainable Development

PONTEFRACT

Finite resources

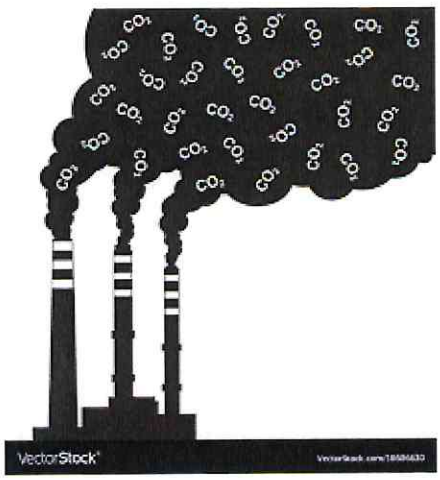
- The picture shows oil, coal and gas which are fossil fuels.
- Fossil fuels are **finite resources** which are processed to provide **energy** and materials.
- Fossil fuels are a **finite** resource because it takes millions of years to form.
- This means it is formed are a much slower rate compared to its use.
- It cannot be replaced as it is used.
- Other examples include nuclear fuels and metals found in ores (rocks that contain the metal).

Using Earth's Resources & Sustainable Development

PONTEFRACT

Finite resources and sustainability

- It is **unsustainable** to keep using **finite resources**.
- Apart from their limited supply, **energy** is also needed to extract **finite resources** so it is also **unsustainable** to continue to extract them.
- This energy often comes from finite energy resources such as coal oil and gas



Using Earth's Resources & Sustainable Development

PONTEFRACT

Finite resources and sustainabiliy

- There are methods to reduce the use of **finite resources**:
  - Use less
  - Recycle
  - Reuse an object
  - Use a renewable alternative
- These methods to reduce the amount of **finite resource** used and the reduce the amount of **energy** needed to extract it and process it into a useful **resource**.

Using Earth's Resources & Sustainable Development

PONTEFRACT

Replacing the Earths Natural Resources Examples

- Below shows how different finite resources have been replaced by those which are renewable.

Use	Finite	Renewable
Clothing	Polyester	Cotton/Wool
Shelter	Bricks/metal	Wood
Electricity	Fossil fuels	Solar panels/wind turbines
Fuel	Fossil fuels	Wood/hydrogen