

# Year 8 Science Knowledge Booklet

## Term 4

Name:	Class:
Homework 1 Due: 1 <sup>st</sup> March	Homework 2 Due: 15 <sup>th</sup> March
Homework 3 Due: 29 <sup>th</sup> March	



## Science Homework 1



Read all of this knowledge organiser. The work covered will be in the first knowledge quiz of the term.

**Big questions:** 

- What is DNA?
- How can DNA be extracted from a nucleus?
- What vocabulary is used in genetics?
- How can we predict which characteristics will be inherited?
- What are genetic disorders?
- What do family trees show?

Key vocabulary	
	-

Genetics	The study of heredity
Mendel	The monk who studied heredity. He is the 'father of genetics'
Reproducible	Getting the same results when investigation different factors (or bay someone
	else doing the investigation)
Watson and Crick	Scientists who discovered the structure of DNA.
DNA	The chemical from which chromosomes are made
Double helix	The shape of DNA
Polymer	A large molecule
Chromosome	Long threads of DNA found in the nucleus and made up of genes.
Gene	A section of DNA that codes for a protein
Gamete	A sex cell
Alleles	Different versions of the same gene
Genotype	Combination of alleles
Phenotype	Physical characteristics that are expressed / coded for (by the genotype)
Dominant allele	An allele that is expressed regardless of whether one or two copies are present.
	A dominant allele hides the effects of a recessive allele
Recessive allele	An allele that is only expressed if two copies are present
Homozygous	Two alleles that are the same (homozygous recessive or homozygous dominant)
Heterozygous	Two different alleles, one dominant and one recessive
Punnet square	A grid that is used for a genetic cross
Genetic disorders	Are abnormal conditions that a person inherits through faulty genes
Mutation	A change in DNA
Cystic fibrosis	A genetic disorder caused by a recessive allele; symptoms include thick mucus
Polydactyly	A genetic disorder caused by a dominant allele; resulting in extra fingers or toes
Carrier	An individual who is heterozygous for a genetic disorder
Family tree	A diagram to show the relationship between individuals in the past and present
Gender	Sex at birth (male or female)
Sex chromosomes	23 <sup>rd</sup> pair of chromosomes. XX – female, XY - male

#### What is DNA?

Genetics is the study of heredity

Mendel was a monk who studied heredity in pea plants. He is known as the father of genetics.

**Watson and Crick** discovered the structure of DNA, with the help of Wilkins and Franklin.

DNA is a **polymer** (large molecule), with two backbones twisted in a **double helix**.



The discovery of DNA structure and sequencing of the human genome was important as it helped scientists to: **i)** Understand the causes of disease, ii) Understand inherited diseases and iii) Trace migration patterns of our ancestors

#### How can DNA be extracted from a nucleus?

DNA is found in the nucleus of cells. Plant cells are crushed to break down the cell wall. A detergent disrupts membranes allowing you to access the DNA inside the nucleus.

#### What vocabulary is used in genetics?

A gamete is a sex cell. In humans, gametes are sperm and eggs (ovum).

**DNA** is a large and complex polymer, which is made up of two strands forming a double helix.

**Chromosomes** are contained inside the cell's nucleus. These are long threads of DNA which are made up of many genes.

A **gene** is a small section of DNA on a chromosome. Genes code for proteins. A gene is the unit of heredity and may be copied and passed on to the next generation.

In gametes (sex cells) chromosomes are single. Human gametes each have 23 chromosomes.

At fertilisation the male and female nuclei fuse so chromosomes found body cells are found in pairs. One chromosome is inherited from the mother and one is inherited from the father. Human **body cells** each have **46 chromosomes**, or **23 pairs**.



The chromosome in each pair carries the same gene in the same location. These genes could be the same, or different versions.

 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.

A genotype (type of genes) is the combination of alleles.

A **phenotype** is the physical characteristic that is expressed (by the genotype).

Alleles may be either dominant or recessive:

A dominant allele is always expressed, regardless of whether one or two copies are present.

Dominant alleles are represented by a **capital letter**, for example, B.

A **recessive allele** is **only expressed** if there are **two copies** (and no dominant alleles). Recessive alleles are represented by a **lower case letter**, for example, b.

Homozygous alleles are two alleles that are the same, for example:

- Homozygous dominant, BB (brown eyes)
- Homozygous recessive, bb (blue eyes)

Heterozygous alleles are two alleles that are different,

- o Bb, (one dominant and one recessive) brown eyes
- This is because a dominant allele hides the effects of a recessive allele

## **Science Homework 2**



Try to answer all of these key knowledge questions. Then check your answers using the last page. These are some of the questions that will be in the knowledge quizzes and the end of term tests.

Key knowledge question	Your answer
Describe the structure of DNA.	
Who discovered the structure of DNA?	
What is a gene?	
How many genes are found in a)human gametes, and b) human body cells?	
What is an allele?	
What is a genotype?	
What are homozygous alleles?	
What are heterozygous alleles?	
What is a phenotype?	
What is a dominant allele and how many are needed for a characteristic to show?	
What is a recessive allele and how many are needed for a characteristic to show?	
What type of square is used to conduct a genetic cross?	
What are genetic disorders?	
Is polydactyl caused by inheriting a dominant or a recessive gene?	
What is a cystic fibrosis carrier?	
What are the sex chromosomes for a) a female and b) a male (at birth)?	

#### How can be predict which characteristics will be inherited?

Genetic crosses of single genes can be shown using Punnett squares.

This shows the possible offspring combinations could be produced, and the **probability** of these genotypes can be calculated.

Eye colour (B-Brown, b-blue)

	В	В
Ь	Bb	Bb
	Brown eyes	Brown eyes
Ь	Bb	Bb
	Brown eyes	Brown eyes

Probability: Brown eyes is 100%

Hair length in cats (H-short, h -long)

	н	h
н	HH short	<u>Hh</u> short
h	Hh short	Hh long

Probability: short hair 75%, long hair 25%

#### What are genetic disorders?

Genetic disorders are abnormal conditions that a person inherits through faulty genes (or chromosomes).

Genetic disorders are caused by **mutations**. A mutation is a change in the DNA. Genetic disorders can be caused by either dominant or recessive alleles. Examples include:

Genetic disorder	Caused by which type of allele	Symptoms
Polydactyly	Dominant	Extra digits on fingers or toes
Cystic Fibrosis	Recessive	Production of thick mucus, impairing function of respiratory system and digestive system



A **carrier** (or genetic carrier) is an individual who is heterozygous for a recessive genetic disorder.

They carry the defective allele, but do not display any symptoms of the disorder.

Inherited disorders can also be predicted using a Punnett square.

#### What do family trees show?

Family trees show the gender (sex) of each individual, past and present.



https://www.researchgate.net/figure/Example-family-tree-as-part-of-a-DNA-reference-profile-collection-form-The-donor-is\_fig2\_334771116

Gender is determined by which sex chromosomes are inherited. Humans have 23 pairs of chromosomes in each body cell. The 23<sup>rd</sup> pair of chromosomes are known as the sex chromosomes. Males and females have different combinations of the sex chromosomes depending on their gender.



A genetic cross for gender is done using a punnet square.

#### Wider reading

#### How to get the most out of your knowledge organiser:

- To get the most use out of the knowledge organisers you should be learning sections and then selftesting.
- There are several different things you can do
  - Look, cover, write, check, correct
  - Read through the organisers
  - Mind maps
  - Key spellings
  - Make a glossary
  - Missing out key words
  - Questions/answers answers/questions
  - Flash cards
  - Revision clock learning
  - Mnemonics

#### Science Learning Tools and wider study:

The Oak Academy – Online Science lessons BBC Bitesize KS3 science <u>You tube channels:</u> Fuse school Ted talks Free science lessons Primrose Kitten <u>Shows on Netfilx</u> Our planet Tiny creatures A life on our planet

#### Genetics

KS3 Revision Monkey Inheritance BBC Bitesize KS3 Inheritance and genetics NHS: Probability, chance and genetic inheritance https://www.youtube.com/watch?v=iBoXpURc1es https://www.bbc.co.uk/bitesize/topics/zpffr82

<u>https://www.genomicseducation.hee.nhs.uk/blog/probability-chance-and-genetic-inheritance/</u> What is inheritance? <u>https://www.yourgenome.org/facts/what-is-inheritance/</u>

Key knowledge question	Answer	
Describe the structure of DNA.	DNA is a polymer and a double helix.	
Who discovered the structure of DNA?	Watson and Crick discovered the structure of DNA, with the help of Franklin and Wilkins.	
Where are chromosomes found?	Chromosomes are found in the nucleus (of eukaryotic cells)	
What is a gene?	A gene is a section of DNA found on a chromosome. Genes code for proteins.	
How many genes are found in a) human	Human gametes contain 23 chromosomes.	
gametes, and b) human body cells?	Human body cells contain 46 chromosomes (or 23 pairs)	
What is an allele?	Alleles are different versions of the same gene.	
What is a genotype?	A genotype is a combination of alleles	
What are homozygous alleles?	Homozygous alleles are two alleles that are the same	
	(homozygous recessive or homozygous dominant)	
What are heterozygous alleles?	Homozygous alleles are two alleles that are the same	
	(homozygous recessive or homozygous dominant)	
What is a phenotype?	Physical characteristics that are expressed / coded for (by the genotype)	
What is a dominant allele and how many are needed for a characteristic to show?	An allele that is expressed regardless of whether one or two copies are present. A dominant allele hides the effects of a recessive allele	
What is a recessive allele and how many are needed for a characteristic to show?	An allele that is only expressed if two copies are present	
What type of square is used to conduct a genetic cross?	A Punnett square	
What are genetic disorders?	Genetic disorders are abnormal conditions that a person inherits through faulty genes (or chromosomes).	
Is polydactyl caused by inheriting a dominant or a recessive gene?	Polydactyl is caused by inheriting a dominant gene.	
What is a cystic fibrosis carrier?	A cystic fibrosis carrier is a person who is heterozygous for cystic fibrosis. They show no symptoms of the disorder as they have a dominant gene, but they have (carry) a recessive gene that could be inherited by their <i>offspring</i> .	
What are the sex chromosomes for a) a	Female sex chromosomes are XX.	
female and b) a male (at birth)?	Male sex chromosomes are XY.	

#### **Big questions:**

- 1. What are Microorganisms?
- 2. What are the differences between the different types of micro-organisms?
- 3. How are diseases transmitted?
- 4. How does the body defend itself against disease?
- 5. How do vaccinations work?
- 6. What is a drug?
- 7. How do drugs affect the body?
- 8. What are the effects of alcohol on the body?
- 9. Why is smoking bad for you?

#### **Key vocabulary**

Antibody	A protein that attaches to pathogen's antigens, to destroy pathogen or to	
	clump them together for easier phagocytosis	
Antigen	A chemical on the pathogen that causes an immune response.	
Antitoxin	A substance that neutralises toxins	
Barrier defence	Eg skin, scabs, tears, mucus. Stops pathogens from entering body	
Clinical trial	Tested on humans; first on healthy volunteers, then in double blind trials	
Communicable	A disease that can be spread	
Depressant	Slows down the brain's activity by making the synapses less active.	
Herd immunity	A significant proportion of the population has immunity, therefore limits	
	the spread of a pathogen. Protects the most vulnerable.	
Immune	Memory cells present, therefore you make antibodies to neutralise/	
	destroy the pathogen without showing any symptoms.	
Medicinal Drug	A drug with a health benefit	
Microbe	Micro-organism- cannot be seen without a microscope	
Pathogen	A microbe that causes disease	
Pre-clinical trial	Tested in a lab; on cells, tissues or animals	
Recreational Drug	A drug taken for pleasure	
Stimulant	A drug that speeds up the brain's activity, make the synapses more active	
Toxin	A harmful substance that damages cells	
Transmission	The spread of a disease/ pathogen	
Vaccine	An dead or inactive form of the pathogen, causes white blood cells to	
	make the specific antibodies, leads to memory cells and immunity	
Vector	An organism that spread pathogens between people eg mosquitos	
White blood cell	Specialised cell to neutralise or destroy pathogen- engulf, produce	
	antibodies, produce antitoxins	

#### What are Microorganisms?

#### What are the differences between the different types of micro-organisms?

Micro-organisms (microbes) are any living thing too small to see without magnification.

Pathogens are microbes that cause disease

- **Viruses** are very tiny and simple, made just of a protein coat and RNA. They enter the host cells, replicate, destroy the cell and invade new cells.
- **Bacteria** survive on the surface of your cells. They produce toxins which make you unwell. They have flagellae to help them move, no membrane bound organelles, loop of free floating DNA, and are surrounded by a protective capsule. They can be treated using antibiotics.
- **Protists** are single celled eukaryotes. To spread from host to host the malarial protist needs to travel inside a mosquito, who sucks up the protist along with the blood of one person and then injects it into the next along with her numbing saliva. An organism that transmits disease is called a VECTOR
- **Fungi** are eukaryotes which are able to digest dead organisms. They are the largest of the 4 pathogens. Fungi secrete enzymes that digest the area of skin. Fungal infections can be treated with anti-fungals/ fungicides.

	Virus	Bacteria	Protist	Fungus
Size	Smallest, very tiny and simple	Very small, approx. 100x smaller than a human cell	Varies with lifecycle	biggest
Appearance	Just genetic material and protein coat	No organelles, loop DNA, cell wall, capsule, sometimes flagellum	Eukaryotic, single cell, mouth pore, contractile vacuoles, cilia	Eukaryotic, can be multicellular, chitin cell wall
Examples of diseases caused	Flu, polio, common cold, AIDS, measles	Tonsillitus, TB, Plague, chlamydia	malaria	Athletes foot, thrush, ringworm, Rose black spot

#### How are diseases transmitted?

A communicable disease can pass from one person to another

Disease/Pathogen	Cause/Pathogen	Method for spread
Gonorrhoea	bacteria	Direct – sexual contact
Black Spot	fungus	Fungal spores distributed by wind, water
Malaria	Protist (Plasmodium)	Vector – carried by mosquito. Eggs laid in water and hatch into larvae in water.

P2.3 GENETICS AND 2.4 DISEASE AND DRUGS			
Disease/Pathogen	Cause/Pathogen	Method for spread	
Measles	virus	Airborne droplets	
HIV	virus	Direct contact – body fluids	
Tobacco mosaic virus	virus	Enters through wounds – spread from infected plants	
Salmonella	bacteria	Eating contaminated food, unhygienic food preparation	

#### To stop the spread of pathogens:

Method	Example	How it works
Sterilising water	Cholera	Chemicals or UV light kill pathogens in unclean water.
Suitable hygiene - food	Salmonella	Cooking foods thoroughly and preparing them in hygienic conditions kills pathogens.
Suitable hygiene - personal	Athlete's foot	Washing surfaces with disinfectants kills pathogens. Treating existing cases of infection kills pathogens.
Vaccination	Measles	Vaccinations introduce a small or weakened version of a pathogen into your body, and the immune system learns how to defend itself.
Contraception	HIV/AIDs	Using barrier contraception, like condoms, stops the transfer of bodily fluids and sexually transmitted diseases.

#### How does the body defend itself against disease?

#### The first line of defence-

The skin acts as a barrier, Hydrochloric acid in the stomach, If our skin is cut, platelets seal the wound by clotting, The breathing organs produce mucus to cover the lining of these organs and trap the microbes

#### Second line of defence-

If microbes enter our body they need to be neutralised or killed. This is done by WHITE BLOOD CELLS

- 1) Engulf the microbe- Phagocytosis
- 2) Produce antibodies to neutralise the microbe- specific antibodies for specific pathogens
- 3) Produce antitoxins to neutralise the toxins produced by microbes

Once you have been exposed to a pathogen, whether naturally or by vaccination, your body contains cells which are able to **rapidly** produce **antibodies** which can bind to the pathogen and cause it to be destroyed by white blood cells.

The pathogen cannot reproduce to cause you to feel ill and so you are IMMUNE.

### **Science Homework 3**



Try to answer all of these key knowledge questions. Then check your answers using the last page. These are some of the questions that will be in the knowledge quizzes and the end of term tests.

Questions in *italics* are from older work.

Key knowledge question	Your answer
How are antibodies specific to one pathogen?	
How does our body protect itself from invading pathogens?	
Name 3 ways that pathogens are spread	
Name the 3 things that white blood cells do to invading pathogens	
Name the 4 types of pathogen	
What are toxins?	
What do protists do to red blood cells?	
What is a pathogen?	
What do we call the process where a white blood cell engulfs a pathogen?	
Name 3 fungal diseases.	
What do we call the smallest particle of a chemical element that can exist?	
What is an element?	
What is the mass of a proton?	
What is the mass of an electron?	

#### How do vaccinations work?

A vaccine stimulates the production of **antibodies** and **memory cells** against the target pathogen, without making the person ill. Once you have been exposed to a pathogen, you will be able to make <u>antibodies</u> quickly in response to any future infection

The pathogen cannot reproduce to cause you to feel ill and so you are **IMMUNE**.

The secondary response is much more **rapid and larger.** This is because the memory cells divide quickly and make antibodies in response to the infection.



Herd **immunity** occurs when a significant portion of a population becomes **immune** to an infectious disease, limiting further disease spread



#### What is a drug?

#### Medicinal drugs:

These are drugs used to treat a condition. They usually have a benefit to your health.

#### **Recreational drugs:**

These are drugs taken for enjoyment, to help relaxation or to stay awake.

These have no health benefits and in many cases are harmful

Many of our medicines today originate from natural sources. Digitalis, a heart drug, comes from foxgloves Aspirin from willow trees. Penicillin from a fungus

#### New drugs are tested to determine safety, dosage levels and how well they work (efficacy)

The main stages are:

1. Preclinical testing in the lab and animals

2. Clinical trials using volunteers: phase I tests for dosage and safety; phase II to monitor efficacy and side effects; phase III to monitor long term effects.

3. Trial results are peer-reviewed and published

#### Drug use can lead to long term health issues

**Drug addiction:** When the body becomes used to the changes caused by a drug. A person does not feel normal without it.

Withdrawal symptoms: Caused when a person may try to stop taking the drug. Symptoms include anxiety, headaches and sometimes pain.

An overdose is when someone takes too much of a drug. This can cause death or serious illness.

Legal recreational drugs can still have a harmful effect on the body. Examples include; Alcohol: can damage the liver, Tobacco: increases risk of cancer, Caffeine: can cause insomnia, risk of heart attacks

#### How do drugs affect the body?

#### In the brain most drugs work by altering activity at the synapse

The signal is transmitted to another neurone across a junction called a **synapse** by chemicals called **neurotransmitters.** 

**Depressants**, such as alcohol and solvents, slow down the brain's activity by making the synapse less active. **Stimulants**, such as nicotine, ecstasy and caffeine, make the synapse more active. **Painkillers**, such as morphine, block nerve impulses that cause pain. **Hallucinogens**, such as LSD distort what the user sees and hears, by effecting the receptors for a particular type of neurotransmitter: serotonin.

#### What are the effects of alcohol on the body?

Alcohol is a chemical called **ethanol**, found in alcoholic drinks. This legal drug can lower your inhibitions and affect your judgement. It is a **depressant** and slows down your reaction times. It is an **addictive** drug that can have serious consequences. It is recommended that men should drink no more than 21 units a week, and women 14 units.

Alcohol can reach the brain in just one minute. Too much alcohol can **damage the brain cells** and cause depression.

The liver breaks down alcohol to remove this toxic drug from the body. Too much alcohol can **damage the liver** leading to **cirrhosis or cancer**.

Alcohol can reduce **fertility** in men and women, for example reduces the amount of sperm a men produces.

Drinking during pregnancy increases the chances of a miscarriage, stillborn and premature babies

**Foetal Alcohol Syndrome:** Poor growth in the womb and after birth, muscle weakness and poor coordination, problems in three or more major areas: thinking, speech, movement, or social skills, heart defects, facial Abnormalities

Compared with non-alcohol using **teenagers**, some alcohol-using teenagers show significantly **smaller brain** volumes and lower density within the areas responsible for **memory and learning** 

#### Why is smoking bad for you?

Cigarettes contain over 4000 chemicals

**Carbon monoxide** – poisonous gas, reduces the amount of oxygen that red blood cells can carry around the body

**Nicotine** – addictive drug that affects the central nervous system, increases the heart rate, narrows the blood vessels, causing high blood pressure

**Tar** – brown, sticky substance that consists of tiny particles formed when tobacco smoke condenses, paralyses tiny hairs in the airways called cilia, this stops them removing mucus easily

Emphysema: Smoking causes the lungs to loses elasticity, and causes the air sacs to stick together.

Cancer: Nicotine and tar cause tumours in the lung tissue

Smoking during **pregnancy** can cause tissue damage in the unborn baby, particularly in the **lung and brain**, and some studies suggest a relationship between tobacco and **miscarriage**. Smoking also increases the risk of **stillbirth** and the risk of **sudden infant death syndrome** (SIDS), also known as "cot death.

Key knowledge question	Answer
How are antibodies specific to one pathogen?	Each pathogen has a specific antigen on it's surface
How does our body stop pathogens from entering? Name 3.	Skin, (hydrochloric) acid in the stomach, platelets/ scabs to seal cuts, mucus to trap microbes (in lungs etc), enzymes in eye (tears).
Name 3 ways that pathogens are spread	Food, water, airborne droplets, insect bites (vectors), direct contact (touch, sexual intercourse), indirect contact (touching surfaces that have pathogens on)
Name the 3 things that white blood cells do to invading pathogens	Engulf (phagocytosis), produce antibodies, produce antitoxins.
Name the 4 types of pathogen	Virus, fungi, bacteria, protist
What are toxins?	Harmful substances that cause damage to cells
What do protists do to red blood cells?	Bursts them
What is a pathogen?	An organism that causes disease
What do we call the process where a white blood cell engulfs a pathogen?	Phagocytosis
Name 3 fungal diseases.	Athletes foot, thrush, ringworm, rose black spot.
What do we call the smallest particle of a chemical element that can exist?	An atom
What is an element?	A substance made of only one type of atom
What is the mass of a proton?	1
What is the mass of an electron?	Negligible/1/1836