THE DUSTON SCHOOL
Knowledge itself is power
4-19

Year 9 Science Knowledge Booklet

Term 2

Name:	**Class:**
Homework 1 Due: 18th November	**Homework 2 Due: 2nd December**
Homework 3 Due: 9th December	

Science Homework 1

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

Big questions: How do forces make objects act?

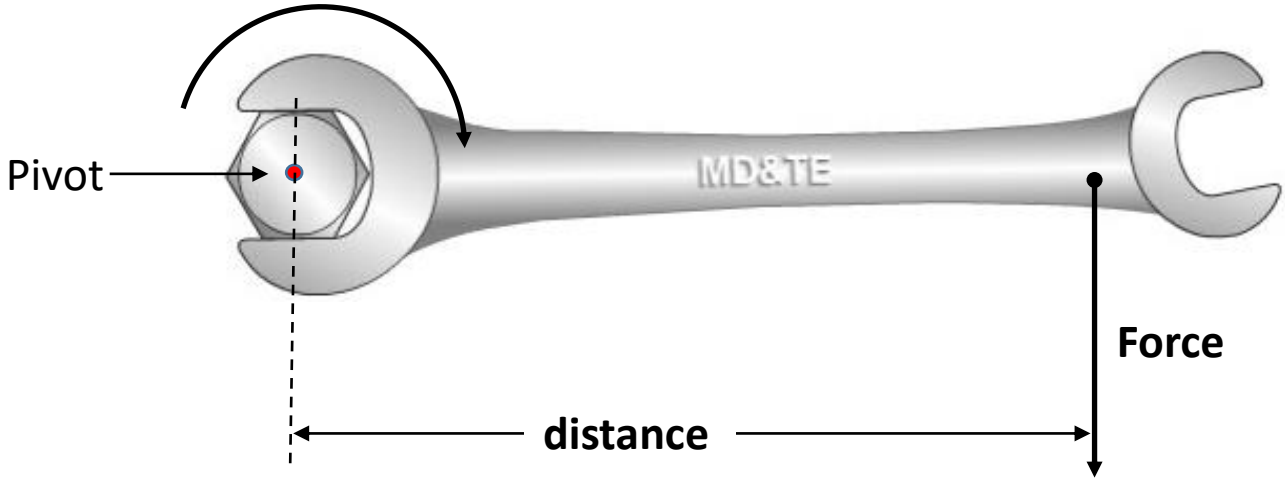
How do forces make things turn?
What do we have to do to get things to balance?
Where is the balancing point of an object?
Why are some things more stable than others?
How do gases exert pressure?
How does pressure change as we go deeper into a fluid?

Key vocabulary

Archimedes Principle	Archimedes principle states: the upthrust on an object is equal to the weight of the fluid displaced.
Centre of gravity	The centre of gravity is the point on an object where the force of gravity (weight) appears to act.
Density	The density of an object is its mass per unit volume.
Equilibrium	An object is in equilibrium is all of the forces and all of the moments are balanced. An object in equilibrium will not speed up or slow down or start or stop turning.
Gas pressure	The pressure exerted by a gas on the walls of its container.
Moment	A turning force is called a moment. When a force acts at a distance from a pivot a turning force or moment is created.
Pascal	One Pascal = one N/m2. The pascal is the unit of pressure.
Pressure	Pressure is the force per unit area exerted on a surface.
Stable / unstable	An object is stable if it is resistant to toppling over. A stable object will return to its original position if moved a small way,
The law of moments	The law of moments states: an object is in equilibrium if the sum of the clockwise moments is equal to the sum of the anticlockwise moments about any point.
Upthrust	An object that displaces a fluid (liquid or gas) experiences an upward force called upthrust.

How do forces make things turn?

- A force can have a turning effect on an object if it acts a distance from a pivot.
- The turning effect of a force is called its moment*.
- The moment of a force can turn clockwise or anti-clockwise if the force is reversed.
- The moment of the force is bigger if the force is bigger or the distance is bigger.



We can calculate the size of the moment of a force by:

$$moment\ of\ a\ force = force \quad \times \quad \begin{matrix} perpendicular\ distance\ from \\ the\ force\ to\ the\ pivot \end{matrix}$$

$$moment = F \times d$$

The **units:**

- of **force** are Newtons, N
- of **distance** are metres, m.
- of the **moment** are Newton metres, Nm.

What do we have to do to get things to balance?

The principle or law of moments says:

- An object is balanced if the sum of the clockwise moments is equal to the sum of the anticlockwise moments.
- When an object is balanced we say that it is in equilibrium.
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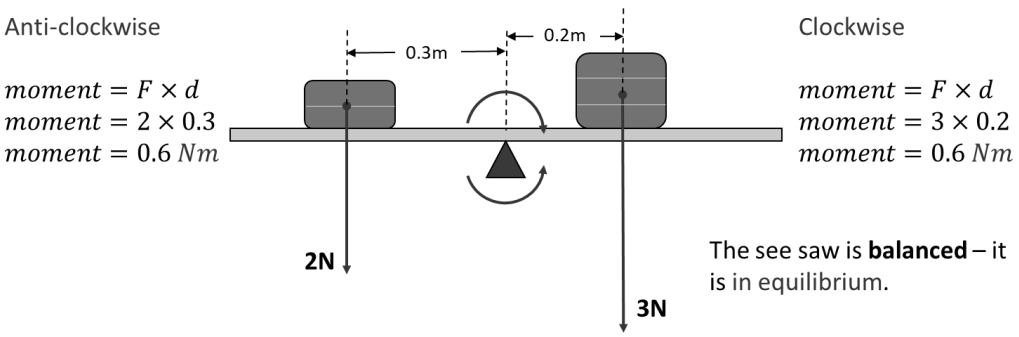
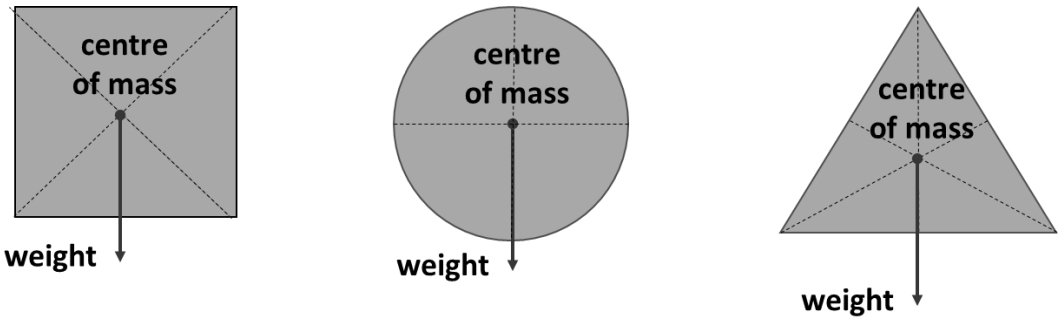
Calculate the moments. Is this object in equilibrium?



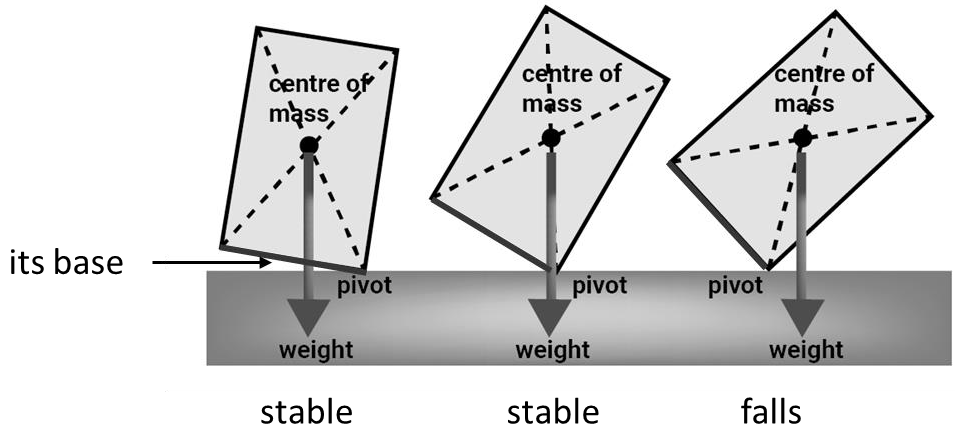
Where is the balancing point of an object?

- Weight is the force of gravity on an object.
- Gravity acts on all objects with mass and acts on every particle in the object:
- The many individual forces can be combined in to one single force called weight acting at the balancing point of the object.
- The single point at which the weight acts is called the centre of mass.
- For regular shaped objects the centre of mass is in the middle of the object.



Why are some things more stable than others?

- An object is stable if it is difficult to knock over. Stable objects can be tipped a long way before they fall over.
- An object falls over if the line of action of its weight fall outside of its base.
- Weight acts from the centre of mass straight downwards.
- An object falls over if the line of action of its weight fall outside of its base.



- An object is more stable if its base is wide.
- An object is more stable if its centre of mass is low down.

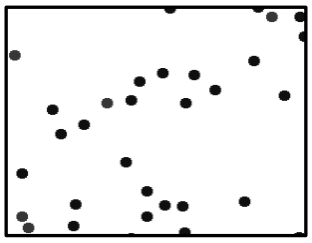
Science Homework 2

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.

Questions in *italics* are from older work.

Key knowledge question	**Your answer**
What do turning forces cause movement around?	
What do we call a turning effect of a force?	
What equation links force, area and pressure?	
What equation links force, distance and moment?	
What happens to air pressure as you get higher in the atmosphere?	
What happens to the kinetic energy of gas particles as temperature increases?	
What is the unit of pressure?	
What unit do we use for moments?	
What word describes the movement of particles in a gas?	
Which would be the best tool to undo a very tight nut, a short or a long spanner?	
Define specific heat capacity of a substance.	
How can you tell from heating curve when state change occurs?	
In which state of matter do particles have the greatest energy?	
Name the change of state that happens when a solid becomes a liquid.	

How do gases exert pressure?



Gases have particles which are in constant motion. They move:

- **At random speeds**
- **In random directions**

They collide frequently with the walls of their container.

Every collision with the walls of the container exerts a force on the container.

This force over the area of the container exerts a pressure on the container*.

Remember: $\boldsymbol{pressure = \frac{Force}{Area}}$

This pressure is called the gas pressure.

- The pressure is measured in newtons per metre squared, N/m^2 or pascal, Pa.
- Pumping up a tyre puts more gas particles into the tyre.
- More gas particles collide more frequently with the walls of the tyre.
- More frequent collisions exert more force and exert more pressure.
- Heating a gas increases the speed of the particles.
- Faster gas particles collide more frequently with the walls of the tyre.
- More frequent collisions exert more force and exert more pressure.

How does pressure change as we go deeper into a fluid?

Objects deep under the ocean have a great weight of water above them. This weight exerts a great force on the surface area of the object.

$\boldsymbol{P = \frac{F}{A}}$ **so the water exerts a great pressure.**

This is called fluid pressure.

Fluid pressure increases with depth.

- The deeper you go the more fluid is above you.
- The more water above you the greater the force from the water and the greater the fluid pressure.
- A spouting can shows the effect of increasing fluid pressure at depth.

The pressure of a fluid can be calculated using:

$$\boldsymbol{Fluid\ pressure = depth \times \begin{matrix} density \\ of\ liquid \end{matrix} \times \begin{matrix} gravitational \\ field\ strength \end{matrix}}$$

$$\boldsymbol{P = h \rho g}$$

- P = the fluid pressure in N/m^2 or Pa
- h = the fluid depth in m.
- ρ = the density of the fluid.
- g = the gravitational field strength = 9.8 N/kg

Key knowledge question	**Answer**
What do turning forces cause movement around?	A pivot or fulcrum
What do we call a turning effect of a force?	A moment
What equation links force, area and pressure?	Pressure = force / area
What equation links force, distance and moment?	Moment = force x distance
What happens to air pressure as you get higher in the atmosphere?	It decreases
What happens to the kinetic energy of gas particles as temperature increases?	Kinetic energy increases
What is the unit of pressure?	Newtons per square metre (N/m^2)
What unit do we use for moments?	Newton metre Nm)
What word describes the movement of particles in a gas?	Random
Which would be the best tool to undo a very tight nut, a short or a long spanner?	A long one
Define specific heat capacity of a substance.	*The energy needed to raise the temperature of 1kg of substance by 1^oC*
How can you tell from heating curve when state change occurs?	*Time is continuing but there is no change in temperature*
In which state of matter do particles have the greatest energy?	*Gases*
Name the change of state that happens when a solid becomes a liquid.	*Melting*

Space

Big questions:

Where is the Earth in Space?

What is the scale of objects in the Solar System?

What is the scale of objects outside the Solar System?

What causes day and night?

What causes the seasons?

Key vocabulary

The Big Bang	The Big Bang theory is the prevailing cosmological description of the development of the universe
Circular motion	The movement of an object along the circumference of a circle or rotation along a circular path.
Galaxy	A system of millions or billions of stars, together with gas and dust, held together by gravitational attraction.
Gravity	The force that attracts a body towards the centre of any other physical body having mass.
Light year	A unit of astronomical distance equivalent to the distance that light travels in one year, which is 9.4607×10^{12} km (nearly 6 million million miles).
Moon	A natural satellite orbiting a planet.
Orbit	The curved path of a celestial object or spacecraft round a star, planet, or moon.
Planet	A celestial body that is in orbit around the Sun.
Satellite	Something orbiting the earth or another planet.
Solar system	The Solar System is the gravitationally bound system of the Sun and the objects that orbit it.
Universe	The universe is all of space and time and their contents, including planets, stars, galaxies, and all other forms of matter and energy.

Where is the Earth in Space?

The Solar System consists of the Sun, with planets and smaller objects such as asteroids and comets in orbit around it. The planets in our solar system are:

Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune

Other than the planets, what other objects are in the Solar System?

- The Sun
- The Moon
- Moons orbiting other planets (e.g. Europa, Titan)
- Dwarf planets (Pluto, Ceres)
- Asteroids
- Comets
-

What is the scale of objects in the Solar System?

Jupiter and Saturn are more than 1000 times the size of Earth.
Uranus and Neptune are more than 400 times the size of Earth.
Venus is approximately the same size as Earth.
Mars is approximately 1/2 the size of Earth.
Mercury is approximately 1/3 the size of Earth.

Planet	**Distance from Sun (million km)**	**Atmosphere**	**Weather**	**Mean Temperature (°C)**
Mercury	58	Very thin	Moon-like, no weather	167
Venus	108	Very thick	Extreme global warming	464
Earth	150	Thick	Temporal/good balance	15
Mars	228	Very thin	Dust storms	-20
Jupiter	779	Very thick	Stormy	-110
Saturn	1434	Very thick	Stormy	-167
Uranus	2873	Thick	Extremely cold	-195
Neptune	4495	Thick	Cold, dark, windy	-200

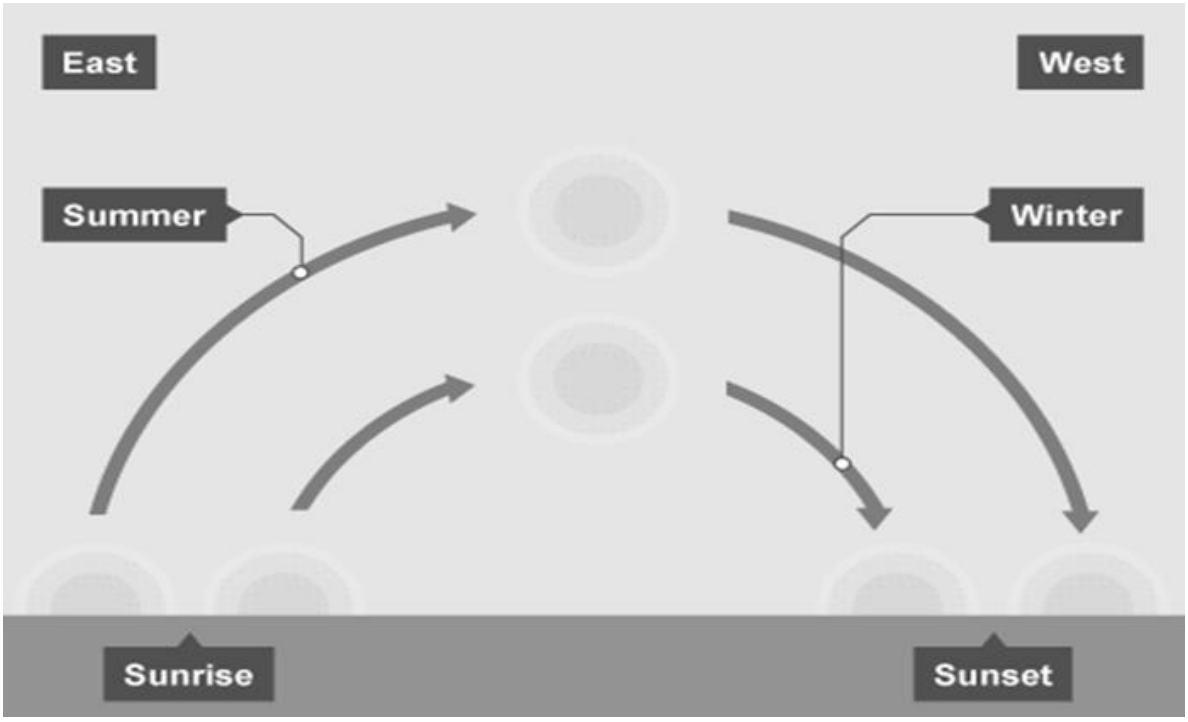
What is the scale of objects outside the Solar System?

Light years

- The distances between objects in space are huge:
- The distance from one star to another in a galaxy is millions of times more than the distance between the planets in the solar system.
- The distance from one galaxy to another is millions of times more than the distance between the stars in a galaxy.
- This means that the numbers used to describe distances in space become very difficult to understand and to write down.
- To get around this problem, scientists use the light year as the unit of astronomical distance. It is the distance travelled by light in one year.

What causes day and night?

- The half of the Earth facing the Sun is in daylight.
- During the day, the Sun appears to move through the sky.
- Remember that this happens because the Earth is spinning on its axis.
- The half facing away from the Sun has no sunlight and so becomes night-time.

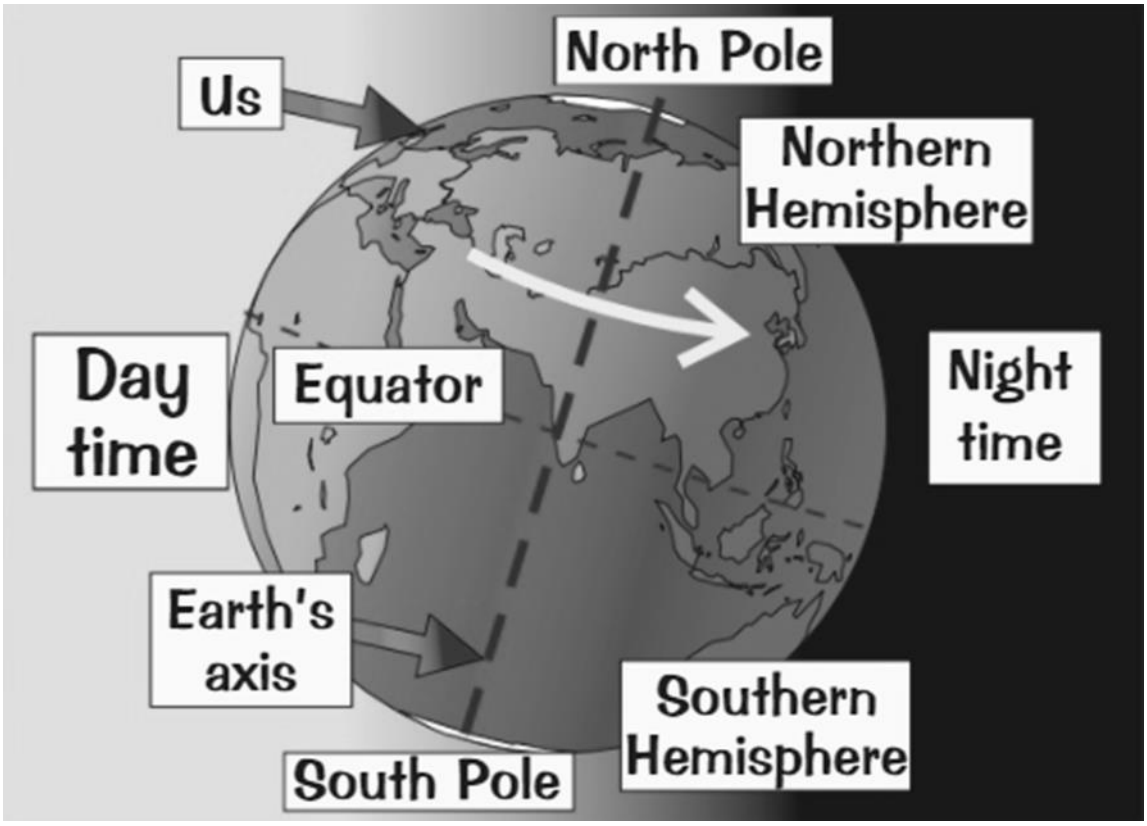


What causes the seasons?

What is a year?

- A planet's year is the time it takes to make one complete orbit around the Sun.
- The Earth goes once round the Sun in one Earth year, which takes 365 Earth days*.

* Its actually 365¼ days. The extra ¼ day is sorted out every leap year.



Due to Earth’s tilted axis, we get different seasons (winter, spring, summer and autumn).

Summer

When it is summer in the UK, the northern hemisphere is tilted towards the Sun

The northern hemisphere spends more time in sunlight than it does in darkness (longer days), so the surface heats up.

The Sun’s rays cover a smaller area of land, so energy transferred is focused on that area.

Winter

When it is winter in the UK, the northern hemisphere is tilted away from the Sun

The northern hemisphere spends less time in sunlight than it does in darkness (shorter days)

The Sun’s rays cover a larger area of land, so energy transferred is spread out over that area.

Disease and Drugs

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

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

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.

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.

<u>How does the body defend itself against disease?</u>

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

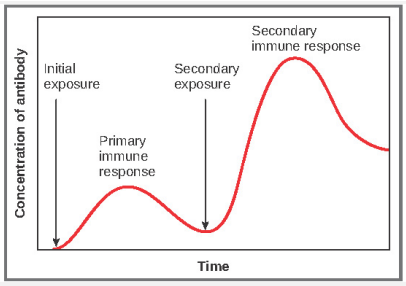
Try to answer all of these key knowledge questions. Then check your answers using the last page. These are some of the questions that will be in the knowledge quizzes and the end of term tests.

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.	
Put these in size order, largest first - galaxy, planet, star, universe	
Roughly how far away is the Sun?	
What equation links mass, gravity and weight?	
What is a light year?	
What is the unit of gravitational field strength?	
What is the unit of mass	
What is the unit of weight?	
Which force keeps the planets in orbit?	
Which planets are called the inner rocky planets?	

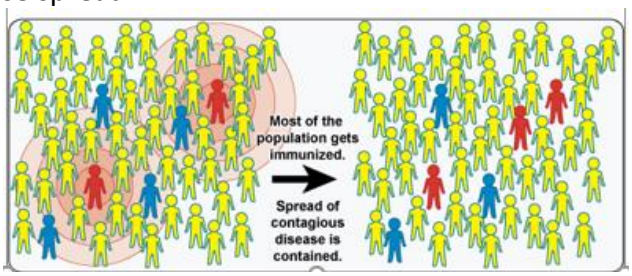
How do vaccinations work?

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 **antibodies** 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.
Put these in size order, largest first - galaxy, planet, star, universe	Universe, galaxy, star, planet
Roughly how far away is the Sun?	150 million kilometres
What equation links mass, gravity and weight?	Weight = mass x gravitational field strength
What is a light year?	A measure of distance, it is the distance travelled by light in one year.
What is the unit of gravitational field strength?	Newtons per kilogram (N/kg)
What is the unit of mass	Kilograms (kg)
What is the unit of weight?	Newtons (N)
Which force keeps the planets in orbit?	Gravity
Which planets are called the inner rocky planets?	Mercury, Venus, Earth and Mars

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 self-testing.

- 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