

# Biology paper 1

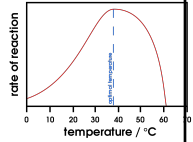
Knowledge organisers

## Enzymes catalyse (increase the rate of) specific reactions in living organisms.

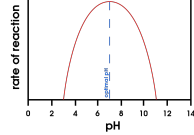
The rate of a reaction can be measured by how fast reactants are used up or by how fast products are formed.

The activity of enzymes is affected by changes in temperature, pH and substrate concentration

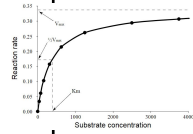
Enzymes activity has an optimum temperature



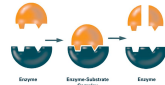
Enzyme activity has an optimum pH



Increasing substrate concentration increases rate (limited by number of active sites)



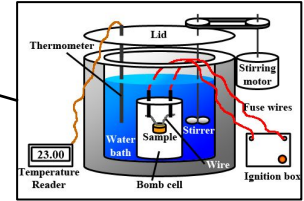
The 'lock and key theory' is a simplified model to explain enzyme action



Enzymes catalyse specific reactions in living organisms due to the shape of their active site.

Calorimeter

The energy in food can be calculated by how much it heats up water when it burns in a calorimeter.



Calculate percentage gain/loss of mass in osmosis.

$$\% \text{ change in mass} = \frac{(\text{final mass} - \text{initial mass})}{\text{initial mass}} \times 100$$

The greater the difference in concentrations the faster the rate of diffusion.

Osmosis

Enzymes

Edexcel  
GCSE Biology  
Key Concepts Part

Large changes in temperature or pH can stop the enzyme from working (denature).

Temperature too high

pH too high or too low

Enzyme changes shape (denatures) the substrate no longer fits the active site.

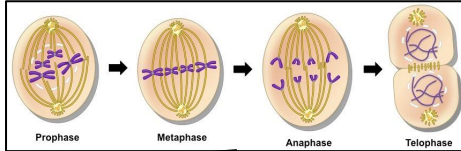
Digestive enzymes speed up the conversion of large insoluble molecules (food) into small soluble molecules that can be absorbed into the bloodstream.

## Transport in cells

The products of digestion are used to build new carbohydrates, lipids and proteins. Some glucose is used for respiration.

Carbohydrases (e.g. amylase)		Made in salivary glands, pancreas, small intestine	Break down carbohydrates to simple sugar (e.g. amylase breaks down starch to glucose).
Proteases		Made in stomach, pancreas	Break down protein to amino acids.
Lipases		Made in pancreas (works in small intestine)	Break down lipids (fats) to glycerol and fatty acids.

Diffusion <u>No</u> energy required	Movement of particles in a solution or gas from a higher to a lower concentration	E.g. O <sub>2</sub> and CO <sub>2</sub> in gas exchange, urea in kidneys. Factors that affect the rate are concentration, temperature and surface area.
Osmosis <u>No</u> energy required	Movement of water from a dilute solution to a more concentrated solution	E.g. Plants absorb water from the soil by osmosis through their root hair cells. Plants use water for several vital processes including photosynthesis and transporting minerals.
Active transport <u>ENERGY</u> required	Movement of particles from a dilute solution to a more concentrated solution	E.g. movement of mineral ions into roots of plants and the movement of glucose into the small intestines.



Mitosis occurs during growth, repair, replacement of cells. Asexual reproduction occurs by mitosis in both plants & simple animals producing genetically identical clones.

MITOSIS produces two genetically identical DIPLOID CELLS

Stage 1	<i>Interphase (not part of mitosis)</i>	Before mitosis: Increase the number of sub-cellular structures e.g. ribosomes, mitochondria. DNA replication makes copies of chromosomes.
Stage 2	<i>Prophase</i>	Nucleus breaks down and spindle fibres appear.
Stage 3	<i>Metaphase</i>	Chromosomes are lined up on spindle fibres on the equator (middle) of the cell.
Stage 4	<i>Anaphase</i>	Chromosome copies are separated and pulled to opposite ends of the cell.
Stage 5	<i>Telophase</i>	A new nuclear membrane forms around each set of chromosomes.
Stage 6	<i>Cytokinesis</i>	Cell surface membrane forms to separate the cells (+new cell wall in plants).

Cells divide in a series of stages to produce two daughter cells, each with identical set of chromosomes to the parent cell (in the nucleus).

MITOSIS is part of THE CELL CYCLE

Cell division and growth

Edexcel GCSE Biology  
Cells and Control Part  
1

Cancer

The result of changes in DNA that lead to uncontrolled growth and division

Growth in organisms

<i>Growth in plants</i>	Cell division and differentiation, elongation (cells increase in length)
<i>Growth in animals</i>	Cell division and differentiation.

Percentile charts can be used to monitor growth

The 50<sup>th</sup> percentile (bold line) is the median (average) growth of the population at that age. Half will be below and half above.

how a cell changes and becomes **specialised** so that different cells can carry out different functions.

Cell differentiation

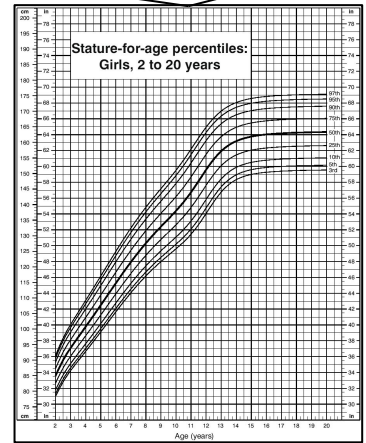
Divides to form more cells of the same type, and can differentiate to form many other cell types.

Undifferentiated cell of an organism

STEM CELLS

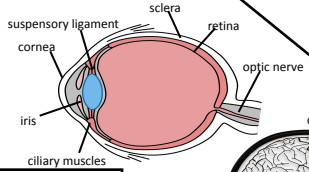
Human Embryonic stem cells	<i>Can be cloned and made to differentiate into any cell type</i>	Therapeutic cloning of stem cells to produce new tissue uses same genes so the body does not reject the tissue. Can be a risk of infection
Adult stem cells	<i>Can form into surrounding human cells e.g. blood cells</i>	Tissue made from adult stem cells is matched to avoid rejection, risk of infection. Only a few types of cells can be formed.
Meristems (plants)	<i>Can differentiate into any plant cell type throughout the life of the plant.</i>	Used to produce clones quickly and economically, e.g. rare species, crop plants with pest /disease resistance

Treatment with stem cells may be able to help conditions such as diabetes and paralysis. Some people object to the use of stem cells on ethical or religious grounds



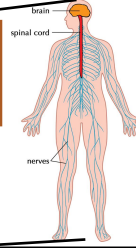
# Sense organ containing receptors sensitive to light intensity and colour

## The Eye



# Edexcel GCSE Biology Cells and Control Part 2

## The human nervous system



Structure of the eye

<b>Retina</b>	Light sensitive cell layer made of rod (light intensity) and cone (red, green, blue colour perception) cells.
<b>Optic nerve</b>	Carries impulse to brain.
<b>Cornea</b>	Transparent layer that covers the pupil and iris.
<b>Iris</b>	Controls size of pupil and the amount of light let in the eyes
<b>Lens</b>	Changes thickness to refract and focus light onto the retina.

Neuro-scientists have been able to overcome difficulties of accessing brain tissue in the skull using CT and PET scanning

(HT) The complexity and delicacy of the brain makes treating brain tumours/spinal injuries very difficult

The brain controls complex behaviour. It is made of billions of interconnected neurones.

## The Brain

(HT) Adult stem cells cannot be differentiated to form neurones in the spinal cord and brain to repair damage/disease

<b>Sensory receptor</b>	Detect stimuli e.g. Pressure cells in skin
<b>Sensory neurone</b>	Long axon carries impulse from receptor to spinal cord.
<b>Synapse</b>	Gap where neurones meet. Chemical message using neurotransmitter.
<b>Relay neurone in CNS</b>	Allows impulses to travel between sensory and motor neurones in the spinal cord.
<b>Motor neurone</b>	Long axon carries impulse from receptor to effector.
<b>Effector</b>	Muscle or gland that carries out response.

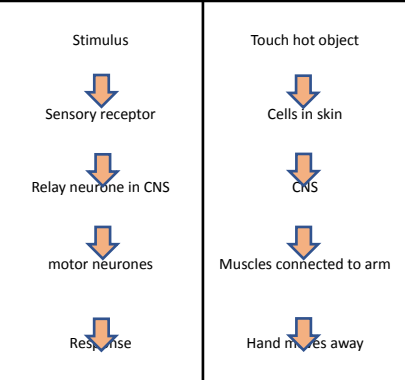
Neurone structure	<b>Axon</b>	Carries electrical impulse to axon terminals.
	<b>Dendron</b>	Carries electrical impulse from receptor cells in sensory neurones.
	<b>Myelin sheath</b>	Insulates the electrical impulse in the neurone.

Synapse (gap where two neurones meet).

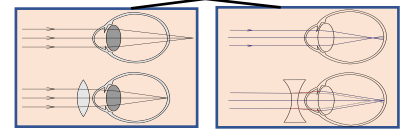
Information from receptors passes along cells (neurones) as electrical impulses to the central nervous system (CNS)

The CNS is the brain and the spinal cord.

Reflex actions are automatic and rapid; they do not involve the conscious part of the brain and can protect humans from harm.



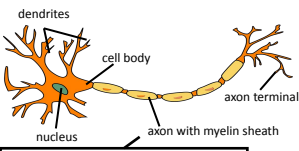
<b>Hyperopia (long sightedness)</b>	<b>Myopia (short sightedness)</b>
Lens can not be made thick enough. Treated using a convex lens so the light is focused on the retina.	Lens too thick. Treated using a concave lens so light is focused on the retina.



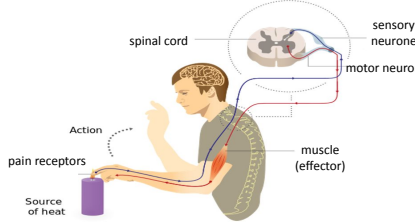
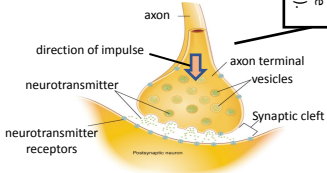
Colour blindness is when cones in the retina do not work properly and some colours cannot be detected.

Cataracts are caused by protein build up in the lens blocking light entering the eye. They can be removed with surgery and an artificial lens inserted.

The brain has different regions that carry out different functions.	<b>Cerebral hemispheres</b>	Largest part of the human brain. Higher thinking skills e.g. speech, decision making.
	<b>Cerebellum</b>	Balance and voluntary muscle function e.g. walking, lifting.
	<b>Medulla oblongata</b>	Involuntary (automatic) body functions e.g. breathing, heart rate.

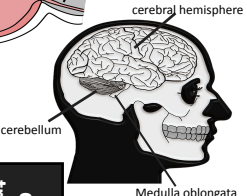
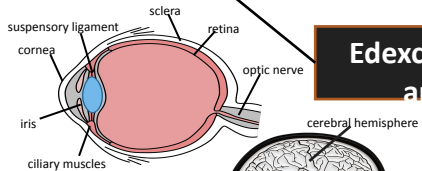


Typical motor neurone



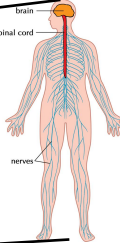
**Sense organ containing receptors sensitive to light intensity and colour**

**The Eye**



**Edexcel GCSE Biology Cells and Control Part 2**

**The human nervous system**



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**The Brain**

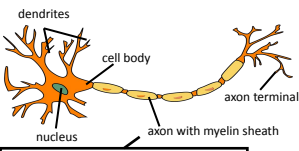
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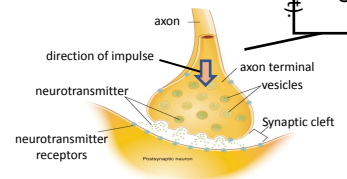
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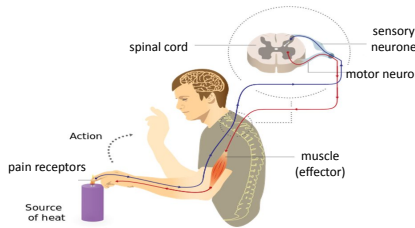
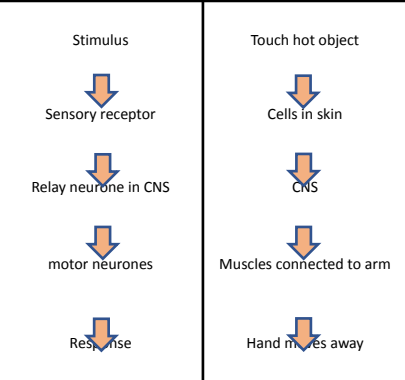


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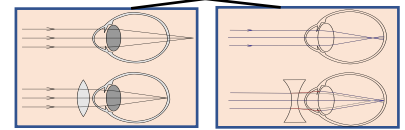
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The genome is the entire DNA of an organism.

All genetic variation arises in mutation, most have no effect on phenotype, some influence but very rarely a single mutation determines phenotype

The whole human genome has now been studied.

It is of great importance for future medical developments

Searching for genes linked to different types of disease.  
Understanding and treatment of inherited disorders.  
Tracing migration patterns from the past.

(Biology HT) Some disorders are inherited on the chromosomes that determine sex (sex linked genetic disorders)

Colour blindness in men.  
  
The X chromosome carries one normal or one faulty allele (the normal is dominant). The shorter Y chromosome does not carry the allele and so X chromosome allele is always expressed in men.

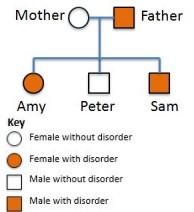
One pair of chromosomes carry the genes that determine sex

	Female	Male
	XX	XY
Gametes	X	Y
X	XX	XY
X	XX	XY

The probability of a male of female child is 50%. The ratio is 1:1

Variation : difference in the characteristics of individuals in a population may be due to

Genetic causes (inheritance)  
Environmental causes (condition they have developed in)  
A combination of genes and environment



Using a family tree. If the father was homozygous dominant then all of the offspring would have the disorder. He must be heterozygous

Inherited disorders

## EDEXCEL GCSE BIOLOGY GENETICS Part 2

The understanding of genetics (biology only)

Gregor Mendel In the mid 19th century carried out breeding experiments on plants

Inheritance of each characteristic is determined by units that are passed on to descendants unchanged.

Variation

Chromosomes had not yet been discovered so the mechanism for inheritance was still unknown.

<b>Gamete</b>	Sex cells produced in meiosis.
<b>Zygote</b>	Single cell that results from fusion of egg and sperm cell.
<b>Chromosome</b>	A long chain of DNA found in the nucleus.
<b>Gene</b>	Small section of DNA that codes for a particular protein.
<b>Allele</b>	Alternate forms of the same gene.
<b>Dominant</b>	A type of allele – always expressed if only one copy present and when paired with a recessive allele.
<b>Recessive</b>	A type of allele – only expressed when paired with another recessive allele.
<b>Homozygous</b>	Pair of the same alleles, dominant or recessive.
<b>Heterozygous</b>	Two different alleles are present 1 dominant and 1 recessive.
<b>Genotype</b>	Alleles that are present for a particular feature e.g. Bb or bb
<b>Phenotype</b>	Physical expression of an allele combination e.g. black fur, blonde hair, blue eyes.

Some characteristics are controlled by a single gene e.g. fur colour, colour blindness.

The alleles present, or genotype operate at a molecular level to develop characteristics that can be expressed as a phenotype.

Most characteristics are as a result of multiple genes interacting.

### Sex determination

Blood groups
Determined by multiple alleles (A,B,O) and codominance
AO, AA blood group A
BO, BB blood group B
OO blood group O
AB blood group AB. A and B are codominant

### Genetic inheritance

Dominant and recessive allele combinations	
Dominant	Recessive
Represented by a capital letter e.g. B.	Represented by a lower case letter e.g. b.
3 possible combinations: Homozygous dominant BB Heterozygous dominant Bb Homozygous recessive bb	

### Using a punnet square (using mouse fur colour as an example)

Parent phenotype	Black fur	White fur
Parent genotype	BB	bb
What gametes are present	In each egg 	In each sperm 
Gametes	b	b
B	Bb	Bb
B	Bb	Bb

The probability of black fur offspring phenotype is 100%. All offspring genotypes are heterozygous (Bb)

Crossing two heterozygous mice (Bb)		
Gametes	B	b
B	BB	Bb
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The probability of black fur is 75% and white fur 25%. The ratio of black to white mice is 3:1

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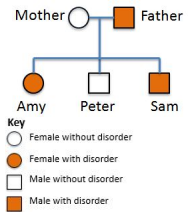
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<b>(Biology only) Solutions to growing human populations</b>	<i>Fertilisers</i>	<b>Advantages:</b> Increases the growth and yield of crop plants.
		<b>Disadvantages:</b> Excess fertiliser can run off into lakes and rivers and cause pollution leading to the death of other plants and animals.
	<i>Biological control</i>	<b>Advantages:</b> Insects can be used to control weed populations. No herbicides are necessary.
		<b>Disadvantages:</b> Introduced insects can complete for non weed plants and disrupt other species food chains.

<b>Risks and benefits (practical and ethical)</b>	
<i>Genetic engineering</i>	<b>Risks:</b> Seeds from GM plants can be very expensive. Some people think eating GM plants is bad for health although there is no evidence to support this view.
	<b>Benefits:</b> decreased use of herbicide with increase in yield from food crops. Medicines tailored for individuals.
<i>Selective breeding</i>	<b>Risks:</b> alleles that may be useful in future may be bred out. Populations with low variation can be vulnerable to genetic diseases.
	<b>Benefits:</b> Increased growth and yield of plants and animals for food.

<b>Advantages and disadvantages of genetic engineering</b>	
<i>Advantages</i>	Modification of crop plants e.g. insect resistance from <i>Bacillus thuringiensis</i> .
	Modification of bacteria to produce human hormones e.g. human insulin made by bacteria.
<i>Disadvantages</i>	Resistant crops could pass on genes to wild plants affecting food chains.  Insulin produced using GM bacteria is not identical to human insulin and not everyone can use it.

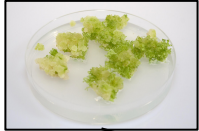
## EDEXCEL GCSE NATURAL SELECTION AND GENETIC MODIFICATION

**Agricultural solutions**

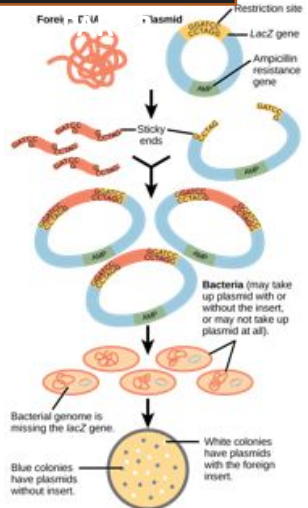
**Risks and benefits**

**Genetic engineering**

**Modification of the genome of an organism to introduce desirable characteristics**



**Tissues cultures**



### Cloning techniques in plants/animals

<i>Tissue culture</i>	Small groups of cells to grow new plants in nutrient solution or solid agar.  <b>Advantage:</b> Important for preservation of rare plants and commercially in nurseries.
	Small groups of human cells used to grow new tissues.  <b>Advantage:</b> matched tissues can be grown that are not rejected by the body's immune system.

### Genetic engineering process (HT only)

1. Restriction enzymes are used to isolate and cut out the required gene.
2. If sticky ends of DNA on the isolated gene and the plasmid DNA match then they can be joined together.
3. DNA is joined in the plasmid DNA using the enzyme ligase – bacterial plasmid or virus.
4. Genes are transferred to plants/animals/microbes in a vector (bacteria or virus) at an early stage of development so they develop the required characteristics.

<b>Genetically modified crops (GMO)</b>	<i>Crops that have genes from other organisms</i>	To become more resistant to insect attack or herbicides.
		To increase the yield of the crop.



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		<b>Disadvantages:</b> Introduced insects can complete for non weed plants and disrupt other species food chains.

<b>Risks and benefits (practical and ethical)</b>	
<i>Genetic engineering</i>	<b>Risks:</b> Seeds from GM plants can be very expensive. Some people think eating GM plants is bad for health although there is no evidence to support this view.
	<b>Benefits:</b> decreased use of herbicide with increase in yield from food crops. Medicines tailored for individuals.
<i>Selective breeding</i>	<b>Risks:</b> alleles that may be useful in future may be bred out. Populations with low variation can be vulnerable to genetic diseases.
	<b>Benefits:</b> Increased growth and yield of plants and animals for food.

<b>Advantages and disadvantages of genetic engineering</b>	
<i>Advantages</i>	Modification of crop plants e.g. insect resistance from <i>Bacillus thuringiensis</i> .
	Modification of bacteria to produce human hormones e.g. human insulin made by bacteria.
<i>Disadvantages</i>	Resistant crops could pass on genes to wild plants affecting food chains.
	Insulin produced using GM bacteria is not identical to human insulin and not everyone can use it.

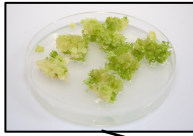
## EDEXCEL GCSE NATURAL SELECTION AND GENETIC MODIFICATION

**Agricultural solutions**

**Risks and benefits**

**Genetic engineering**

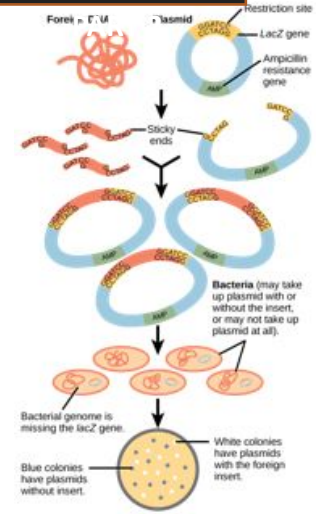
**Modification of the genome of an organism to introduce desirable characteristics**



**Tissues cultures**

### Cloning techniques in plants/animals

<i>Tissue culture</i>	Small groups of cells to grow new plants in nutrient solution or solid agar. <b>Advantage:</b> Important for preservation of rare plants and commercially in nurseries.
	Small groups of human cells used to grow new tissues. <b>Advantage:</b> matched tissues can be grown that are not rejected by the body's immune system.



### Genetic engineering process (HT only)

1. Restriction enzymes are used to isolate and cut out the required gene.
2. If sticky ends of DNA on the isolated gene and the plasmid DNA match then they can be joined together.
3. DNA is joined in the plasmid DNA using the enzyme ligase – bacterial plasmid or virus.
4. Genes are transferred to plants/animals/microbes in a vector (bacteria or virus) at an early stage of development so they develop the required characteristics.

<b>Genetically modified crops (GMO)</b>	<i>Crops that have genes from other organisms</i>	To become more resistant to insect attack or herbicides.
		To increase the yield of the crop.

Healthy weight can be calculated using waist:hip ratio and the equation for BMI.

$$BMI = \frac{\text{mass (kg)}}{(\text{height (m)})^2}$$

Non-communicable diseases are caused by the interaction of a number of factors	Disease	Interacting factors  Diet, obesity, smoking, drinking alcohol, lack of exercise, genetics.
	Cardiovascular disease	
	Cancer	
	Lung disease	
	Liver disease	
Malnutrition		

Lifestyle factors and their effects on non-communicable disease	Disease	lifestyle factors
	Obesity and malnutrition	Lack of exercise and consuming too many/too few calories through an unbalanced diet. Schools meals are balanced to combat this in young people.
	Liver disease	Large amounts of alcohol taken over a long period of time can lead to liver disease e.g. cirrhosis. The NHS spends over £500 million a year treating liver disease.
	Cardiovascular disease	Smoking leads to damage and blocking of arteries supplying the heart with oxygenated blood. WHO estimates that 6 million people die globally as a result of smoking related illnesses.

Drugs (including antibiotics) have to be tested and trialled before to check they are safe and effective

New drugs are extensively tested for:	Efficacy	Make sure the drug works
	Toxicity	Check that the drug is not poisonous
	Dose	The most suitable amount to take

Preclinical trials - using cells, tissues and live animals - must be carried out before the drug can be tested on humans.

Clinical trials use healthy volunteers and patients

Stage 1	Stage 2	Stage 3	Stage 4
Healthy volunteers try small dose of the drug to check it is safe record any side effects	A small number of patients try the drug at a low dose to see if it works	A larger number of patients; different doses are trialled to find the optimum dose	A double blind trial will occur. The patients are divided into groups. Some will be given the drug and some a placebo.



Double blind trial: patients and scientists do not know who receives the new drug or placebo until the end of the trial. This avoids bias.

A placebo can look identical to the new drug but contain no active ingredients

### Non-communicable diseases

## EDEXCEL GCSE HEALTH DISEASE AND MEDICINE part

Treating CVD

### Monoclonal antibodies (Biology only HT)

Evaluating different treatments for cardiovascular disease (CVD)		
Life long medication	Surgical procedures	Lifestyle changes
Medicines to reduce blood pressure and cholesterol. Statins for lowering cholesterol carry a small risk of developing diabetes.	A stent can be surgically inserted into blocked blood vessel. Blocked blood vessels can be bypassed with inserted blood vessels. This treatment requires life long medication.	Giving up smoking, drinking excess alcohol and taking more exercise can reduce the risk of CVD. Some patients may not stick to lifestyle changes.

Monoclonal antibodies	Identical copies of one types of antibody produced in laboratory	1. A mouse is injected with pathogen.
		2. Lymphocytes produce antibodies (but do not divide).
		3. Lymphocytes are removed from the mouse and fused with rapidly dividing mouse tumour cells.
		4. The new cells are called hybridomas.
		5. The hybridomas divide rapidly and release lots of antibodies which are then collected.

Monoclonal antibodies can be used in a variety of ways	
Testing	Diagnosis
e.g. pregnancy test – measure the level of hormones	Can detect very small quantities of chemicals in the blood

Specific to one binding site on the antigen. Can target specific chemicals or cells in the body unlike drug and radiotherapy treatments

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