

*Each DNA molecule is packed into a [REDACTED].*

1

*[REDACTED] contain instructions for making [REDACTED].*

2

*The two strands of DNA twist to form a [REDACTED].*

3

*When replicating, the [REDACTED] between the DNA strands break, and [REDACTED] come to bind with the exposed ones on the separated strands to form new strands.*

4

*Proteins act alone or in [REDACTED] to perform many cellular functions.*

5

*The four DNA bases are...*

6

*A [REDACTED] backbone provides structure for the DNA.*

7

*[REDACTED] bonds hold the two strands of DNA together.*

8

*Genes contain instructions for making proteins.*

*Each DNA molecule is packed into a chromosome.*

2

1

*When replicating, the hydrogen bonds between the DNA strands break, and new bases come to bind with the exposed ones on the separated strands to form new strands.*

*The two strands of DNA twist to form a double helix.*

4

3

*Adenine, Thymine, Guanine, Cytosine*

*Proteins act alone or in complexes to perform many cellular functions.*

6

5

*Hydrogen bonds hold the two strands of DNA together.*

*A sugar-phosphate backbone provides structure for the DNA.*

8

7

\_\_\_\_\_ binds to \_\_\_\_\_, \_\_\_\_\_ binds to \_\_\_\_\_

9

*Before a cell divides, its DNA is duplicated using \_\_\_\_\_.*

10

*What is the Karyotype?*

11

*What is an autosome?*

12

*In addition to the autosomes, what other chromosomes are there?*

13

\_\_\_\_\_ is the process where a sperm producing cell or an egg producing cell makes a new cell with 23 chromosomes.

14

\_\_\_\_\_ is when an exact replica of the genome is made (46 chromosomes).

15

\_\_\_\_\_ is when only one chromosome from each pair is passed on to the new \_\_\_\_\_ (sperm/egg).

16

*Before a cell divides, its DNA is duplicated using semi-conservative replication.*

10

*Adenine binds to Thymine, Cytosine binds to Guanine.*

9

*One of the 22 pairs of normal chromosomes in humans.*

12

*The 23 pairs of chromosomes in the cell.*

11

*Meiosis is the process where a sperm producing cell or an egg producing cell makes a new cell with 23 chromosomes.*

14

*One pair of sex chromosomes.*

13

*Meiosis is when only one chromosome from each pair is passed on to the new gamete (sperm/egg).*

16

*Mitosis is when an exact replica of the genome is made (46 chromosomes).*

15

DNA  → RNA  → protein

17

When a gene is , it forms many  molecules.

18

molecules get  into proteins.

19

Define an allele

20

Define polymorphism (in the context of DNA)

21

is when a person has two copies of one allele on a gene locus.

22

is when a person has two different alleles on a gene locus.

23

A gene is  if the  protein that it produces can be compensated for by the correct protein produced by .

24

*When a gene is transcribed, it forms many RNA molecules.*

*$DNA \xrightarrow{\text{transcription}} RNA \xrightarrow{\text{translation}} \text{protein}$*

18

17

*Any of several forms of a gene, usually arising through mutation. Alleles are responsible for hereditary variation.*

*RNA molecules get translated into proteins.*

20

19

*Homozygous is when a person has two copies of one allele on a gene locus.*

*The existence of several alleles for one gene locus. Individuals have one or two alleles per locus.*

22

21

*A gene is recessive if the mutated protein that it produces can be compensated for by the correct protein produced by an alternative allele.*

*Heterozygous is when a person has two different alleles on a gene locus.*

24

23

If a mutated gene produces proteins that fulfil a new function, then it may be , since the original function will be fulfilled by .

25

Genes can be ,  or .

26

Define genotype.

27

Define phenotype

28

The phenotype is controlled by  derived from , and the .

29

What bloodgroup is made from two co-dominant alleles?

30

Blood groups:

	$I^A$	$I^B$	$i$
$I^A$	<input type="text"/>	<input type="text"/>	<input type="text"/>
$I^B$	<input type="text"/>	<input type="text"/>	<input type="text"/>
$i$	<input type="text"/>	<input type="text"/>	<input type="text"/>

31

Allele frequency is linked to  to its  in a given .

32

Genes can be recessive, dominant or co-dominant.

If a mutated gene produces proteins that fulfil a new function, then it may be co-dominant, since the original function will be fulfilled by the other allele.

26

25

The physical appearance of an individual, including its observable or measurable traits.

The genetic make-up of an individual, which includes the genes or alleles present in it.

28

27

AB

The phenotype is controlled by proteins derived from genes, and the environment.

30

29

Allele frequency is linked to the fitness it provides to its carriers in a given environment.

Blood groups:

	$I^A$	$I^B$	$i$
$I^A$	A	AB	A
$I^B$	AB	B	B
$i$	A	B	O

32

31



Define genetic fitness

33

If an allele provides \_\_\_\_\_, it is likely to \_\_\_\_\_ and become \_\_\_\_\_ in a given population.

34

Mutations have allowed us to \_\_\_\_\_ our diet. This includes a mutation that lets us produce \_\_\_\_\_ during adulthood (to drink milk) and another one that reduces the function of a \_\_\_\_\_ allowing us to eat broccoli and sprouts! This is an example of \_\_\_\_\_.

35

Carriers of \_\_\_\_\_ alleles are \_\_\_\_\_ and get protection from malaria.

36

Carriers of \_\_\_\_\_ alleles die if they are \_\_\_\_\_ since their haemoglobin does not function well.

37

People \_\_\_\_\_ for a mutation affecting \_\_\_\_\_ are asymptomatic and immune to HIV. Probably because this gave protection against \_\_\_\_\_ and \_\_\_\_\_ in the past. This mutation is less effective against pathogens from \_\_\_\_\_.

38

Environment interaction can influence the genotype. \_\_\_\_\_ and \_\_\_\_\_ are sensitive to temperature, and change colour at different temperatures. This is caused by temperature sensitive \_\_\_\_\_.

39

The environment affects the phenotype; a \_\_\_\_\_ can make a human twin grow to be smaller, and flowers have \_\_\_\_\_ based on the soil \_\_\_\_\_.

40

*If an allele provides an advantage, it is likely to persist and become more prominent in a given population.*

34

*The reproductive success of a genotype, measured as the number of offspring produced by and individual that survive to a reproductive age relative to the average age for the population.*

33

*Carriers of sickle cell anaemia alleles are asymptomatic and get protection from malaria.*

36

*Mutations have allowed us to diversify our diet. This includes a mutation that lets us produce lactase during adulthood (to drink milk) and another one that reduces the function of a bitter substance taste receptor allowing us to eat broccoli and sprouts! This is an example of natural selection.*

35

*People homozygous for a mutation affecting CCR5 are asymptomatic and immune to HIV. Probably because this gave protection against the plague and smallpox in the past. This mutation is less effective against pathogens from developing countries.*

38

*Carriers of sickle cell anaemia alleles die if they are homozygous since their haemoglobin does not function well.*

37

*The environment affects the phenotype; a worse diet can make a human twin grow to be smaller, and flowers have different colours based on the soil pH.*

40

*Environment interaction can influence the genotype. Himalayan rabbits and arctic foxes are sensitive to temperature, and change colour at different temperatures. This is caused by temperature sensitive tyrosine.*

39

Most [redacted] are due to several genes and the environment (e.g. [redacted], [redacted], [redacted]).

41

A greater similarity between [redacted] for a particular [redacted] compared to [redacted] provides evidence that [redacted] factors play a role.

42

[redacted] twins share all their genes and their home environment. [redacted] twins share [redacted] their genes and a home environment.

43

Define a mutation

44

The size of mutations ranges from [redacted]  
( [redacted] - SNP) to  
[redacted]  
( [redacted] )

45

SNP mutations are [redacted], chromosome rearrangements are [redacted]

46

Define a hereditary mutation.

47

Define an acquired (somatic) mutation.

48

*A greater similarity between identical twins for a particular trait compared to fraternal twins provides evidence that genetic factors play a role.*

42

*Most phenotypes are due to several genes and the environment (e.g. skin colour, height, weight).*

41

*A **permanent** alteration in the DNA sequence passed on into daughter cells (and sometimes gametes).*

44

*Identical twins share all their genes and their home environment. Fraternal twins share half their genes and a home environment.*

43

*SNP mutations are micro-mutations, chromosome rearrangements are macro-mutations*

46

*The size of mutations ranges from a single base pair (single nucleotide polymorphism - SNP) to large segments of a chromosome (chromosome rearrangement)*

45

*When a mutation occurs at some point in a person's life, and is present only in the cell that it occurred and its daughter cells (through mitosis).*

48

*A mutation inherited from a parent gamete and present throughout a person's life and in every cell in their body. This can be passed on to progeny through meiosis.*

47

*Environmental factors that cause mutations include...*

49

*Intrinsic factors causing mutations include...*

50

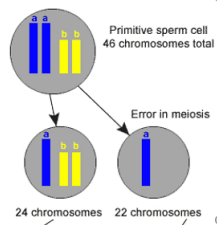
*Macro mutations occur during [ ] or in [ ]*

51

*Mutations during meiosis include...*

52

*What will these mutations result in when the gamete is combined with another?*



53

*Single chromosome macro-mutations include...*

54

*Examples of diseases caused by macro-mutations include [ ], [ ] and [ ].*

55

*What are the three types of substitution micro-mutations and what are they caused by?*

56

*Errors during DNA replication (before mitosis) and repair.  
Errors during meiosis (e.g. an error in chromosome  
separation).*

50

*Mutagens; chemicals, radiation etc that causes breaks between  
DNA bases. Biological factors such as viruses that can  
integrate into the genome and cause disturbances in the DNA.*

49

*Trisomy (when a sperm has an extra chromosome) or  
monosomy (when a sperm has one too few chromosomes).*

52

*Macro mutations occur during meiosis or in late stage cancers*

51

*Within one chromosome; deletion, duplication and inversion  
of regions of the chromosome. Within two chromosomes, part  
of one can go into another (insertion), parts of chromosomes  
can swap places (translocation).*

54

*Left is trisomy, right is monosomy.*

53

*Caused by single base substitutions (SNP), and they are silent,  
nonsense (STOP) and mis-sense.*

56

*Examples of diseases caused by macro-mutations include down  
syndrome, klinefelter syndrome and Cri du chat.*

55

*How does a nonsense mutation occur?*

57

*What is a silent mutation?*

58

*What is a mis-sense mutation?*

59

\_\_\_\_\_ can cause great disturbances to a protein through \_\_\_\_\_ unless the number of bases \_\_\_\_\_, so there is no \_\_\_\_\_

60

There are \_\_\_\_\_ bad (but \_\_\_\_\_) alleles for cystic fibrosis.  
The normal gene \_\_\_\_\_.  
Patient must be \_\_\_\_\_ for one bad allele, or \_\_\_\_\_ for two.

61

\_\_\_\_\_ are when a person has many repeats of a base pair triplet. \_\_\_\_\_ dictates the likelihood of a person getting certain diseases (more is worse for the patient).

62

Sometimes a SNP in a region far away from a gene can cause problems. In the case of lactose intolerance, a pair 13910 bases before the relevant gene is substituted (from T to C), meaning a protein cannot bind. This is recessive, since just a bit of lactase does the job.

63

The Human Genome project took \_\_\_\_\_ to sequence \_\_\_\_\_ base pairs. DNA from \_\_\_\_\_ individuals of \_\_\_\_\_ was taken.

64

*When the protein coded for by a triplet is not changed by an SNP.*

58

*When a SNP (single base substitution) converts a triplet from coding a protein to coding a STOP signal.*

57

*Insertions and deletions can cause great disturbances to a protein through frameshift mutations unless the number of bases is divisible by three, so there is no frameshift*

60

*When a SNP mutation changes the protein coded for by a triplet.*

59

*Trinucleotide repeated expansions are when a person has many repeats of a base pair triplet. The number of repeats dictates the likelihood of a person getting certain diseases (more is worse for the patient).*

62

*There are 900 bad (but recessive) alleles for cystic fibrosis. The normal gene produces enough protein to compensate. Patient must be homozygous for one bad allele, or heterozygous for two.*

61

*The Human Genome project took 13 years to sequence 3 billion base pairs. DNA from 5 anonymous individuals of varying ethnicity was taken.*

64

*Sometimes a SNP in a region far away from a gene can cause problems. In the case of lactose intolerance, a pair 13910 bases before the relevant gene is substituted (from T to C), meaning a protein cannot bind. This is recessive, since just a bit of lactase does the job.*

63



*It was discovered that humans only have [redacted] genes, but it was thought that humans should have around [redacted]. This was because flies have [redacted] and humans are more complicated!*

65

*Humans share [redacted] of their genes with flies, and only [redacted] of the human DNA codes for genes.*

66

*Why can humans get by with so few genes?*

67

*Cells have the [redacted], but do not express the [redacted]. Where these [redacted] are expressed determines the type of cell formed.*

68

*Humans genomes differ by about [redacted], which is about [redacted] base pairs which are mostly [redacted]*

69

*The frequency of SNP's is one in every [redacted] base pairs. Most are [redacted] and have [redacted].*

70

*SNP's outside of genes are useful because...*

71

*GWAS stands for...*

72

*Humans share sixty percent of their genes with flies, and only two percent of the human DNA codes for genes.*

66

*It was discovered that humans only have 20,500 genes, but it was thought that humans should have around 100,000. This was because flies have 13,000 and humans are more complicated!*

65

*Cells have the same genome, but do not express the same genes and isoforms. Where these proteins are expressed determines the type of cell formed.*

68

*Alternative splicing; the same gene can produce different proteins when it is shaped differently (isoforms). This means that we can make 100k proteins with 23k genes.*

67

*The frequency of SNP's is one in every 300 base pairs. Most are outside genes and have no effect on the phenotype.*

70

*Humans genomes differ by about 0.01 percent, which is about 3 million base pairs which are mostly SNP's*

69

*Genome wide association studies*

72

*They act as landmarks for us as scientists!*

71

Most diseases result from [REDACTED], patients with [REDACTED] have been found to be more at risk of developing some diseases.

73

GWAS aim to identify the common SNP's associated with [REDACTED] by testing at least [REDACTED] of SNP's in large population samples.

74

Where are the samples for GWAS taken from

75

When particular landmark SNP's are seen in greater diseased patients compared to controls, we say that the SNP's are [REDACTED] with the disease.

76

If a patient has SNP's associated with a disease, what does it mean?

77

Some people will be affected more by [REDACTED] if they have SNP's associated to a disease in their genome (e.g. are far more likely to get a disease if they smoke).

78

What is pharmacogenomics?

79

In 2005, [REDACTED] SNP's were known to be associated with diseases, in 2008, it was [REDACTED] and now it's over [REDACTED].

80

*GWAS aim to identify the common SNP's associated with complex diseases and traits by testing at least hundreds of thousands of SNP's in large population samples.*

74

*Most diseases result from polygenic and environmental interactions, patients with particular groups of landmark SNP's have been found to be more at risk of developing some diseases.*

73

*When particular landmark SNP's are seen in greater diseased patients compared to controls, we say that the SNP's are associated with the disease.*

76

*Both patients who have the disease and people who do not (the control).*

75

*Some people will be affected more by their environment if they have SNP's associated to a disease in their genome (e.g. are far more likely to get a disease if they smoke).*

78

*The patient as a higher risk of the disease (very rarely, there could be a 100 percent association).*

77

*In 2005, less than 50 SNP's were known to be associated with diseases, in 2008, it was over 500 and now it's over 14,000.*

80

*How do patients genomes affect their response to a treatment?*

79

What was the aim of the 1000 genomes project?

81

On average, each person carries [REDACTED] loss of function variants in annotated genes, and [REDACTED] previously implicated in inherited disorders.

82

How many new disease causing mutations were identified in the 1000 genomes project?

83

In [REDACTED] the 100,000 genomes project was started by [REDACTED]. It was split between helping [REDACTED] and [REDACTED].

84

The 100,000 genomes project sampled [REDACTED] people including [REDACTED] serious illness patients. [REDACTED] cancer patient genomes (one cancer and one normal per patient), and [REDACTED] rare disease genomes (three per patient; [REDACTED])

85

[REDACTED] and [REDACTED] both let you get your genome sequenced. [REDACTED] does not offer much advice or counselling, but [REDACTED] does, and is therefore more expensive.

86

Immunlumina tests healthy adults interested in learning about their risk for [REDACTED], assessing their [REDACTED] status and understanding their response to certain [REDACTED].

87

How many different types of cell are there in humans?

88

<p><i>On average, each person carries 250-300 loss of function variants in annotated genes, and 50-100 previously implicated in inherited disorders.</i></p>	<p><i>To establish the most detailed catalogue of human genetic variations.</i></p>
82	81
<p><i>In 2014 the 100,000 genomes project was started by the NHS. It was split between helping cancer patients and patients with rare diseases.</i></p>	671
84	83
<p><i>23andMe and Illumina both let you get your genome sequenced. 23andMe does not offer much advice or counselling, but illumina does, and is therefore more expensive.</i></p>	<p><i>The 100,000 genomes project sampled 75,000 people including 40,000 serious illness patients. 50,000 cancer patient genomes (one cancer and one normal per patient), and 50,000 rare disease genomes (three per patient; one patient genome and two blood relatives))</i></p>
86	85
<p><i>220 cell types.</i></p>	<p><i>Immumina tests healthy adults interested in learning about their risk for a set of adult-onset conditions, assessing their carrier status and understanding their response to certain drugs.</i></p>
88	87

<p><i>What is the first cell created by the fusion of the egg and sperm?</i></p>	<p><i>What are the initial cells formed from the zygote called?</i></p>
89	90
<p><i>After there are more than 8 blastomeres, what is there?</i></p>	<p><i>What is the trophoblast?</i></p>
91	92
<p><i>Where does the embryo form from?</i></p>	<p><i>When the [redacted] is dividing, the cells become smaller since they are partitioning the [redacted] cytoplasm via mitosis.</i></p>
93	94
<p><i>What lets the embryo attach to the wall of the uterus?</i></p>	<p><i>[redacted] is driven by the [redacted]. The [redacted] expands and changes shape and location, but is still [redacted].</i></p>
95	96

*Blastomeres*

*The zygote.*

90

89

*The embryo after it was a blastocyst (5 days). Separate from the inner cell mass*

*A blastocyst a ball of cells.*

92

91

*When the inner cell mass is dividing, the cells become smaller since they are partitioning the zygote cytoplasm via mitosis.*

*The inner cell mass, not the trophoblast.*

94

93

*uterine implantation is driven by the trophoblast. The Inner cell mass expands and changes shape and location, but is still only one type of cell.*

*The trophoblast*

96

95



<p>Once attached to the uterus wall, the inner cell mass sets the [redacted]. The [redacted] is the [redacted] axis.) The body is symmetrical along this.</p> <p>97</p>	<p>After setting the axis, [redacted] takes place. This is where cells migrate, along the bottom, endoderm form, [redacted] in the middle [redacted] at the top. [redacted] will be the skin and nerves, [redacted] forms [redacted] and the [redacted] forms the [redacted]</p> <p>98</p>
<p>What is a highly coordinated cell movement?</p> <p>99</p>	<p>What structures become the vertebrae?</p> <p>100</p>
<p>What do somites eventually form into?</p> <p>101</p>	<p>Growing organs is called...</p> <p>102</p>
<p>By saying organogenesis is progressive, we mean</p> <p>103</p>	<p>What is used as a reference for growing specialised cells in an embryo?</p> <p>104</p>

*After setting the axis, gastrulation takes place. This is where cells migrate, along the bottom, endoderm form, mesoderm in the middle and ectoderm at the top. ectoderm will be the skin and nerves, mesoderm forms muscles, blood, skeleton, heart etc and the endoderm forms the digestive system, lungs etc*

98

*Once attached to the uterus wall, the inner cell mass sets the axis of the body. The primitive streak is the anterior posterior (head to tail) axis.) The body is symmetrical along this.*

97

*Somites; they emit signals telling what organs to form where.*

*Gastrulation*

100

99

*Organogenesis*

*Muscles, vertebral column and dermis of the skin. They are landmarks for organ formation during development.*

102

101

*The head to tail framework.*

*That the organs grow in stages, e.g. there is a little growth for the arm first, then it gets longer, then it gets digits etc.*

104

103

<p>What is a differentiated cell?</p>				<p>The gurdon experiment was done on...</p>			
105				106			
<p>The gurdon experiment involves...</p>				<p>Cells developmental potential (potency) changes how as it gets more specialised?</p>			
107				108			
<p>What is involved in a grafting experiment?</p>				<p>The fate of a cell [redacted] before differentiation. They can sometimes [redacted] a new situation, up to [redacted].</p>			
109				110			
Source	Potential	Type of cell	Can develop into	<p>Once a cell is differentiated...</p>			
Zygote	[redacted]	-	Whole organism.				
[redacted]	[redacted] and self-renewing	Embryonic stem cell	Any cell type				
Adult	Multipotent, [redacted]	multipotent	Some cell types				
Organ	Limited potential and renewal	[redacted]	Choice of between [redacted] types				
-	Limited division	committed progenitor	1 type, locked fate.				
-	No division	Differentiated	No division.				
111				112			

*Frogs*

*One where the shape, structure and function is well defined.*

106

105

*It decreases.*

*Taking egg cells, removing the nuclei and inserting nuclei from either a small embryo or a developed intestine cell. The former usually develop into tadpoles, but the latter mostly stop developing before the tadpole stage.*

108

107

*The fate of a cell can be locked before differentiation. They can sometimes not adapt to a new situation, up to 4 generations before.*

*Cells from an early gastrula (early embryo) that would form an eye are taken and transplanted into an host embryo (oldest), as well as ones from an neurula (older embryo than gastrula). The ones from the younger embryo develop into anything depending where they are implanted, the ones from the older embryo develop into eyes.*

110

109

*It has a clear cut identity and expresses specific proteins for morphology and function.*

<i>Source</i>	<i>Potential</i>	<i>Type of cell</i>	<i>Can develop into</i>
<i>Zygote</i>	<i>Totipotent</i>	-	<i>Whole organism.</i>
<i>Blasocyst</i>	<i>Pluripotent and self-renewing</i>	<i>Embryonic stem cell</i>	<i>Any cell type</i>
<i>Adult</i>	<i>Multipotent, self-renewing</i>	<i>multipotent stem cells</i>	<i>Some cell types</i>
<i>Organ</i>	<i>Limited potential and renewal</i>	<i>Progenitor</i>	<i>Choice of between 2-6 types</i>
-	<i>Limited division</i>	<i>committed progenitor</i>	<i>1 type, locked fate.</i>
-	<i>No division</i>	<i>Differentiated</i>	<i>No division.</i>

112

111

<p><i>Cells have the same genes, but it's how they express their genes that makes them different.</i></p> <p>113</p>	<p><i>At any given time, each cell expresses around [redacted] of its genes</i></p> <p>114</p>
<p><i>About [redacted] of the [redacted] active genes are developmental genes.</i></p> <p>115</p>	<p><i>Developmental genes control:</i></p> <p>116</p>
<p><i>One small difference in gene expression can [redacted].</i></p> <p>117</p>	<p><i>Proteins inside the egg are [redacted].</i></p> <p>118</p>
<p><i>After two [redacted] of the zygote (egg to two cells, to four), the [redacted] are in the cytoplasm. After division two, the cells have different maternal proteins after division, so they have different gene expressions and more differences occur after each cell division onwards.</i></p> <p>119</p>	<p><i>Describe the cell lineage of insulin producing beta cells.</i></p> <p>120</p>

*At any given time, each cell expresses around 20 percent of its genes*

114

*Cells have the same genes, but it's how they express their genes that makes them different.*

113

*Proteins that regulate genes expression (turn genes on and off), proteins involved in cell communication or signalling (tell other cells what genes to turn on and off).*

116

*About ten percent of the 20 percent active genes are developmental genes.*

115

*Proteins inside the egg are not uniformly distributed.*

118

*One small difference in gene expression can create a cascade of changes downstream.*

117

*Fertilised egg (zygote) → inner cell mass → endoderm → pancreas → endocrine → beta cell*

120

*After two cleavage divisions of the zygote (egg to two cells, to four), the same maternal proteins are in the cytoplasm. After division two, the cells have different maternal proteins after division, so they have different gene expressions and more differences occur after each cell division onwards.*

119

A differentiated cell can give rise to a new organism (totipotency), which means genes are expressed as a cell specialises.

121

Transcription factors are proteins that bind to the DNA and regulate gene expression. They change how the DNA is shaped so that different parts can be accessed.

122

The embryo starts with a zygote (fertilised egg). It becomes a blastocyst with a blastocoel and inner cell mass (ICM). Before full differentiation, cells are pluripotent and are able to become any cell type. At the gene level, cells become different by the expression of different genes. The initial differences come from the genes being unevenly distributed in the blastocyst. As cells form from the ICM, they end up not having the same gene expression profile.

123

Pluripotent stem cells can become any cell.

124

Embryonic stem cells have the minimum level of specialisation, while somatic cells have the maximum level of specialisation.

125

Embryonic stem cells are not stem cells, but somatic cells are.

126

The 16-cell stage is the limit for totipotency in humans.

127

Stem cells in the ICM are pluripotent.

128

*Epigenetics are proteins that bind to the DNA and retrieve totipotency. They change how the DNA is shaped so that different parts can be accessed.*

122

*A differentiated cell can give rise to a new organism (totipotent), which means genes are not lost as a cell specialises.*

121

*Totipotent stem cells can become any cell.*

124

*The embryo starts with a zygote (totipotent).  
It becomes a blastocyst with a trophoblast and ICM (pluripotent)  
Before full differentiation, cells become locked in their fate and are determined  
At the gene level, cells become different by expressing different developmental genes  
The initial differences come from the maternal developmental proteins being unevenly distributed in the egg cytoplasm. As blastomeres form from cleavage divisions, they end up not having the same developmental proteins.*

123

*Committed progenitor cells are not stem cells, but progenitor cells are.*

126

*totipotent stem cells have the minimum level of specialisation, differentiated cells have the maximum level of specialisation.*

125

*Stem cells in the ICM are pluripotent.*

128

*8 cell stage is the limit for totipotency in humans.*

127



*Adult stem cells are [REDACTED].*

129

*Adult stem cells are found in...*

130

*Embryonic stem cells are [REDACTED] and [REDACTED].*

131

*In order to control ESL's in vitro, we can [REDACTED] culture medium, or [REDACTED].*

132

*Adult stem cells are [REDACTED] to grow in the lab than [REDACTED] but do show [REDACTED].*

133

*Describe the plasticity of ASC's*

134

*What are the most apparently plastic cells?*

135

*Why are UC-MSC's better than BM-MSC's?*

136

*Brain, Skin, Bone Marrow, Skeletal muscle, Intestines (any cell that needs regrowth).*

130

*Adult stem cells are multipotent.*

129

*In order to control ESL's in vitro, we can change the chemical composition of the culture medium, or insert specific genes into cells.*

132

*Embryonic stem cells are immortal and pluripotent.*

131

*Most adult stem cells can trans-differentiate in the lab, but this is a low efficiency process.*

*Adult stem cells are harder to grow in the lab than ESC's but do show some plasticity.*

134

133

- *Less immunogenic*
- *longer telomeres*
- *less DNA damage*
- *non-invasive to harvest*
- *same plasticity as BM-MSCs.*

*Mesenchymal stem cells (mesoderm), which can transform into liver cells (endoderm) and brain cells (ectoderm)*

136

135

*How many proteins are usually considered for immuno-compatibility?*

137

*What is GVHD?*

138

*Why are neonatal (UC cells) less immunogenic?*

139

*Neonatal cells have longer [REDACTED] (which [REDACTED]), since they get shorter [REDACTED] since they do not get replicated, and neonatal cells have not divided many times.*

140

*In ESC's what enzyme is expressed that stops a telomeres from getting shorter?*

141

*When is telomerase turned off?*

142

*What enzyme do most cancer cells produce and why?*

143

*What is a bank of ESC lines?*

144

*Graft Vs Host Disease, where the immune cells in the transplant attack the host.*

5

138

137

*Neonatal cells have longer telomeres (which indicate the age of the cell), since they get shorter at each cell division since they do not get replicated, and neonatal cells have not divided many times.*

*Embryos and fetuses have to evade the mother's immune system, so there are less surface markers on cells. Also, newly born babies have no/little immune system so there is less chance of GVHD.*

140

139

*Before the baby is born*

*Telomerase*

142

141

*A bank of embryonic stem cells, where each 'line' of cells is derived from a single embryo.*

*Telomerase so that the cells are immortal and divide indefinitely.*

144

143

<p><i>What are the three sources of human stem cells?</i></p> <p>145</p>	<p><i>How could we make a stem cell with only some skin cells?</i></p> <p>146</p>
<p><i>What are the currently approved stem cell based therapies?</i></p> <p>147</p>	<p><i>How does a bone marrow transplant to cure leukaemia work?</i></p> <p>148</p>
<p><i>Give an example of tissue engineering</i></p> <p>149</p>	<p><i>What is ex-vivo and in-situ cartilage engineering</i></p> <p>150</p>
<p><i>List advantages of MSC's</i></p> <p>151</p>	<p><i>MSC's might be good for <span style="background-color: #cccccc; display: inline-block; width: 100px; height: 1em; vertical-align: middle;"></span> e.g. with HMC's since they help other stem cells to graft</i></p> <p>152</p>

*Make it into an induced pluripotent stem cell in the lab.*

*Embryonic SC's, Neonatal SC's, adult SC's (bone marrow, fat tissue (liposuction), skin).*

146

145

*1. Get a matching donor 2. Replicate stem cells ex vitro 3. Destroy bone marrow in patient using irradiation and chemotherapy 4. transplant stem cells into patient.*

*Skin grafts, Hematopoietic SC transplant from adult bone marrow or neonatal cells.*

148

147

*Growing new cartilage outside the body and in the body respectively (using MSC's to stimulate growth).*

*Remove cells from lungs, hips and nose, remove a donor trachea (from cadaver) and remove all cells, grow cells around trachea and transplant in patient.*

150

149

*MSC's might be good for cotransplants e.g. with HMC's since they help other stem cells to graft*

- *Easy to isolate*
- Plastic (not literally!) in the lab*
- Can be -frozen and thawed*
- Possess potent immuno-suppression and -anti-inflammation effects*
- Capable of homing (going to site of -injury)*
- Stimulate regeneration*

152

151

<p><i>Clinical trials take [REDACTED], and [REDACTED] therapies are in phase 3 for stem cell treatments. Foreign clinics advertise MSC treatments, but none have published data from clinical trials.</i></p> <p>153</p>	<p><i>Most trials for stem cell therapies are carried out with MSC's ([REDACTED]), HSC's count for [REDACTED]. ESC's are around [REDACTED] and are being tested with [REDACTED] since they are [REDACTED].</i></p> <p>154</p>
<p><i>SC's can be used for [REDACTED], [REDACTED] and [REDACTED].</i></p> <p>155</p>	<p><i>For repairing and replacing cells, what type of cell should we use?</i></p> <p>156</p>
<p><i>What is an induced pluripotent stem cell?</i></p> <p>157</p>	<p><i>How to do Parkinson's in a dish?</i></p> <p>158</p>
<p><i>The traditional approach to medicine is [REDACTED].</i></p> <p>159</p>	<p><i>The traditional approach to medicine does not take into account [REDACTED], which is successful for some, but not all patients.</i></p> <p>160</p>

*Most trials for stem cell therapies are carried out with MSC's (70 percent), HSC's count for 20 percent. ESC's are around 2 percent and are being tested with eyes since they are immuno-privileged.*

154

*Clinical trials take a long time, and less than 10 therapies are in phase 3 for stem cell treatments. Foreign clinics advertise MSC treatments, but none have published data from clinical trials.*

153

*The patients own cells (autologous transplants). This requires adult stem cells that are reasonably plastic though, and its hard to isolate ASC's in the lab. Otherwise, use donor SC's with low immunogenicity.*

156

*SC's can be used for replacing cells (e.g. transplants), repairing cells (e.g. genetically modify SC's outside the body and re-implant) and protecting via MSC immunosuppression.*

155

- *Collect skin cells*
- Re-program them into stem cells*
- Grow -brain cells from them (induce brain cell -differentiation)*
- Stress out the brain cells with -toxins*
- Observe Parkinson's-like features*

158

*When you reprogram a normal (e.g. skin) cell by inserting genes (via viruses or otherwise). Only 3-4 gene insertions required.*

157

*The traditional approach to medicine does not take into account individual differences between patients, which is successful for some, but not all patients.*

160

*The traditional approach to medicine is one size fits all.*

159



<p>What is stratified medicine?</p>	<p>Personalised medicine (aka [redacted]) takes into account individual differences such as [redacted], [redacted] and [redacted].</p>
161	162
<p>Examples of historical personalised medicine include...</p>	<p>When the human genome project started, [redacted] drugs had pharmacogenetic information. After it ended, [redacted] drugs had this information and ten years later, there [redacted] drugs. Now the [redacted], [redacted], [redacted] and [redacted] are examined.</p>
163	164
<p>Genetic changes of interest include [redacted], [redacted], [redacted] and [redacted]. These all change how much of the proteins coded for by an affected gene is produced.</p>	<p>What are the advantages of personalised medicine (6 things)?</p>
165	166
<p>What genes increase your risk of breast and ovarian cancer and how much by?</p>	<p>There are over [redacted] predictive tests looking at [redacted] genes. They can [redacted] of treating patients.</p>
167	168

*Personalised medicine (aka precision medicine) takes into account individual differences such as genes, environment and lifestyle.*

162

*Targeting different types of specific diseases made up of lots of different genes e.g. maturity onset diabetes*

161

*When the human genome project started, 4 drugs had pharmacogenetic information. After it ended, 46 drugs had this information and ten years later, there 104 drugs. Now the genome, proteome, metabolome and epigenome are examined.*

164

*Inheritance of alkaptonuria, blood transfusions using blood capability testing, genetic basis of selective toxicity of an antimalarial drug.*

163

- *Shift reaction to prevention*
- *Predict susceptibility of developing a disease*
- *Improve dosing of drugs (increase efficiency, reduce side effects)*
- *Reduce cost, time and attrition rate in drug development*
- *Decrease adverse affects of drugs, increase diagnostic and detection power for disease*

166

*Genetic changes of interest include SNP's, base insertions, copy-number variations and variable number tandem repeats. These all change how much of the proteins coded for by an affected gene is produced.*

165

*There are over 15000 predictive tests looking at 2800 genes. They can save the cost of treating patients.*

*BRAC1, BRAC2; 85 percent higher lifetime chance of breast cancer and 60 percent chance of ovarian cancer.*

168

167

<p><i>Even if a predictive test for a gene doesn't have an associated drug to lower risk, you can</i></p> <p><i>Sergey Brin does this for Alzheimer's!</i></p> <p>169</p>	<p><i>It's easy to take biopsy of cancer tumours (because they're by definition, not needed), so they can have their genome sequenced to see what genes the cancers have.</i></p> <p>170</p>
<p><i>There are drugs (Ivacaftor) that target the</i></p> <p><i>of diseases rather than just treating symptoms.</i></p> <p>171</p>	<p><i>What does metastatic cancer mean?</i></p> <p>172</p>
<p><i>Enzymes metabolise drugs, and</i></p> <p><i>metabolise over percent of drugs. There are</i></p> <p><i>in genes that code for these enzymes. Some people metabolise fast (and are at risk of</i></p> <p><i>), or even ultra-fast metabolisers (meaning the drugs</i></p> <p>173</p>	<p><i>After a stent has been put into , the body recognises it as foreign and blood will clot around it. A drug is given to stop clotting, but one enzyme ( ) converts the drug from inactive to active. Variations in this enzyme mean not as much is converted, meaning the blood can clot possibly causing a heart attack or stroke.</i></p> <p>174</p>
<p><i>What are some problems with personalised medicine?</i></p> <p>175</p>	<p><i>What are the ethical problems with personalised medicine (5 things)?</i></p> <p>176</p>

*It's easy to take biopsy of cancer tumours (because they're by definition, not needed), so they can have their genome sequenced to see what genes the cancers have.*

170

*Even if a predictive test for a gene doesn't have an associated drug to lower risk, you can change environmental factors (e.g. eat better, stop smoking etc). Sergey Brin does this for Alzheimer's!*

169

*When the cancer has moved from the original site to other areas of the body.*

172

*There are drugs (Ivacaftor) that target the gene underlying cause of diseases rather than just treating symptoms.*

171

*After a stent has been put into an artery, the body recognises it as foreign and blood will clot around it. A drug is given to stop clotting, but one enzyme (CYP 2C19) converts the drug from inactive to active. Variations in this enzyme mean not as much is converted, meaning the blood can clot possibly causing a heart attack or stroke.*

174

*Enzymes metabolise drugs, and one family of enzymes metabolise over 90 percent of drugs. There are thousands of mutations in genes that code for these enzymes. Some people metabolise fast (and are at risk of overdose toxicity), or even ultra-fast metabolisers (meaning the drugs are broken down before they have an effect).*

173

*Who sees the data? How will it be stored? How will it be used? Could it be used against us? What legal protection do we have?*

176

*Ethics, multiple gene variations per disease, quantity of data*

175

<p> [redacted] mutations can be involve with genes.  Drugs need to target driver mutations in order to be effective. </p> <p>177</p>	<p>Define biomarker</p> <p>178</p>
<p>Why are biomarkers helpful?</p> <p>179</p>	<p> [redacted] can be used to build up a signature,  telling us how multiple [redacted] etc contribute  towards a disease </p> <p>180</p>
<p> [redacted] and [redacted] are used to identify genes  involved in diseases. </p> <p>181</p>	<p> Given a patient, we can use [redacted],  [redacted] and [redacted] (detecting  antigens on the surface of cells) to determine their  biomarkers. These can be gotten from  [redacted], [redacted], [redacted], [redacted] etc.  Anywhere where we [redacted] in the body. </p> <p>182</p>
<p>How do DNA chips work?</p> <p>183</p>	<p>What is the name for a test that goes with a drug?</p> <p>184</p>

*A naturally occurring molecule, gene or characteristic by which a particular pathological or physiological process, disease etc can be identified.*

178

*Driver and passenger mutations can be involve with genes. Drugs need to target driver mutations in order to be effective.*

177

*multiple biomarkers can be used to build up a signature, telling us how multiple genes/proteins etc contribute towards a disease*

180

*Because they help with prediction, diagnosis, progression, regression, or the outcome of treatment of a disease.*

179

*Given a patient, we can use DNA sequencing, microarrays and immunohistochemistry (detecting antigens on the surface of cells) to determine their biomarkers. These can be gotten from normal or diseased tissue, blood, saliva, sweat etc. Anywhere where we can find protein or DNA in the body.*

182

*GWAS and microarrays are used to identify genes involved in diseases.*

181

*A companion diagnostic (CDx).*

*First, sample DNA is taken, then it is amplified using PCR. It is then placed on a DNA chip with many probes, where it will bind to probes that it is complementary to. The chip is washed to remove the non-bound DNA, then scanned, where the bound probes will be visible.*

184

183

<p><i>Oncotype Dx identifies █ genes associated with █ and █ housekeeping genes (used as a control). These are used to give a score of 1-100 giving the likely reoccurrence of █ within the next █ years. It also predicts the response to █. This costs █.</i></p>	<p><i>█ determines how aggressive a █ tumor is (i.e. whether there is a high or low risk of █). It measures the mRNA of █ genes. A biopsy is taken and determined to make sure that █ or more cells are cancerous, then the tissue is used for a █.</i></p>
185	186
<p><i>What is ecosystem services?</i></p>	<p><i>Give examples of ecosystem services.</i></p>
187	188
<p><i>Biological resources include...</i></p>	<p><i>What are the social benefits to biodiversity?</i></p>
189	190
<p><i>Define biodiversity</i></p>	<p><i>What are the three main levels of biodiversity.</i></p>
191	192

*MammaPrint determines how aggressive a breast cancer tumor is (i.e. whether there is a high or low risk of metastasis). It measures the mRNA of 1900 genes. A biopsy is taken and determined to make sure that thirty percent or more cells are cancerous, then the tissue is used for a microarray.*

186

*Oncotype Dx identifies 16 genes associated with breast cancer and 5 housekeeping genes (used as a control). These are used to give a score of 1-100 giving the likely reoccurrence of the tumor within the next ten years. It also predicts the response to chemotherapy. This costs \$4175.*

185

*Protection of water resources, controbution to climate stability, maintenance of ecosystems, pollution breakdown and absorption, nutrient storage and recycling, soil formation etc...*

188

*Involves putting a value on a service that protects biodiversity. E.g. instead of building a dam, work out how much preseving a forest can help water retention (protecting water resources).*

187

*Research, recreation and tourism, culture.*

190

*Food, medical resources and pharmaceutical drugs (e.g. stuff in rainforests), wood, ornamental plants, breeding stocks, gene diversity.*

189

*Genetic diversity, species diversity, ecosystem diversity.*

192

*The variety of life at all levels; gene level, population level, species level, ecosystem level. Also, the interactions between these living things.*

191



*Define genetic diversity*

193

*What does a low genetic diversity mean?*

194

*A small population is prone to positive feedback loops that draw it down an [REDACTED].*

195

*Define genetic drift*

196

*Extinction vortex: small population means interbreeding and genetic drift, so there is a loss of genetic diversity, meaning that there is a reduction in individual fitness and population adaptability so there is lower reproduction and a higher mortality.*

197

*What (is the biggest thing that) makes species susceptible to extinction?*

198

*Cheetah has a [REDACTED] because it had a [REDACTED] near the last ice age ([REDACTED]) and they had an isolated populations in North Africa and Asia are [REDACTED].*

199

*Greater Prairie Chicken were fragmented by [REDACTED], and then found to exhibit a decreased fertility. In order to try to save the colonies, genetic variation was imported by [REDACTED], and the declining populations rebounded, confirming that [REDACTED] was causing the [REDACTED].*

200

*The key factor driving the extinction vortex is the loss of genetic variation since variation is necessary for evolutionary responses to environmental change.*

194

*The combination of different genes found within a population of a single species, and the pattern of variation found within different populations of the same species.*

193

*When a population has little genetic variation, any disease that all individuals are susceptible to could kill the whole population.*

196

*A small population is prone to positive feedback loops that draw it down an extinction vortex.*

195

*Small population size; i.e. rare species are most at risk.*

198

*Extinction vortex: small population means interbreeding and genetic drift, so there is a loss of genetic diversity, meaning that there is a reduction in individual fitness and population adaptability so there is lower reproduction and a higher mortality.*

197

*Greater Prairie Chicken were fragmented by agriculture, and then found to exhibit a decreased fertility. In order to try to save the colonies, genetic variation was imported by taking birds from larger populations, and the declining populations rebounded, confirming that low genetic variation was causing the extinction vortex.*

200

*Cheetah has a low genetic variation because it had a genetic bottleneck near the last ice age (only a few individuals survived) and they had an isolated populations in North Africa and Asia are still genetically similar.*

199

*Define species diversity*

201

*Define species richness*

202

*Define species evenness*

203

*Define ecosystem diversity*

204

*An ecosystem can [redacted] such as a whole forest or  
a [redacted] such as a pond.*

205

*Give four causes of biodiversity loss*

206

*Most threatened species are imperilled*

*[redacted]*

207

*Give the three types of (endangered) species*

208

*The number of different species in a particular area.*

*The variety and abundance of different types of organisms which inhabit an area.*

202

201

*Encompasses the variety of habitats that occur in a region, or the mosaic of patches found within a landscape*

*The relative abundance with which each species is represented in an area (e.g. lots more grey than red squirrels).*

204

203

*Habitat loss, introduced species, over exploitation, pollution.*

*An ecosystem can cover a large area such as a whole forest or a small area such as a pond.*

206

205

*Rare, dominant and keystone*

*Most threatened species are imperilled for more than one reason.*

208

207

<p><i>What is a rare species?</i></p> <p>209</p>	<p><i>What is a dominant species?</i></p> <p>210</p>
<p><i>What is a keystone species?</i></p> <p>211</p>	<p><i>Conserving biodiversity aims to look for [redacted] by mapping biodiversity by region (richness, levels of threat) and by country. These areas are ranked and preserved.</i></p> <p>212</p>
<p><i>Hotspots have three aspects; [redacted], [redacted] and [redacted]. These rarely overlap.</i></p> <p>213</p>	<p><i>There are [redacted] hotspots in the world containing [redacted] of the worlds threatened vertebrates and only cover [redacted] of the earth's surface.</i></p> <p>214</p>
<p><i>Costa Rica has [redacted] percent of global biodiversity, but only [redacted] percent of the land surface of earth. It has the highest [redacted] per kilometer squared in the world, and [redacted] of the country is conserved.</i></p> <p>215</p>	<p><i>The Isthmohyla rivularis frog was thought to be extinct in [redacted] for [redacted] years before a [redacted] was spotted in [redacted].</i></p> <p>216</p>

*A species that supports many other species. Saving these often helps many others.*

210

*A species that has a small population.*

209

*Conserving biodiversity aims to look for hotspots by mapping biodiversity by region (richness, levels of threat) and by country. These areas are ranked and preserved.*

212

*A keystone species is a species whose very presence contributes to a diversity of life and whose extinction would lead to the extinction of many others. They help support the whole ecosystem.*

211

*There are 34 hotspots in the world containing seventy five percent of the world's threatened vertebrates and only cover two point three percent of the earth's surface.*

214

*Hotspots have three aspects; richness, threatened species and endemic (unique to a location) species. These rarely overlap.*

213

*The *Isthmohyla rivularis* frog was thought to be extinct in Costa Rica for 20 years before a female was spotted in 2008.*

216

*Costa Rica has 4 percent of global biodiversity, but only 0.01 percent of the land surface of earth. It has the highest species richness per kilometer squared in the world, and half of the country is conserved.*

215

<p><i>Why is the threat of invasive species a growing problem (4 things).</i></p> <p>217</p>	<p><i>Define an alien species</i></p> <p>218</p>
<p><i>Define native</i></p> <p>219</p>	<p><i>Define endemic</i></p> <p>220</p>
<p><i>Define non-native species (NNS)</i></p> <p>221</p>	<p><i>Define Naturalised</i></p> <p>222</p>
<p><i>Define invasive</i></p> <p>223</p>	<p><i>Define Invasive non-native</i></p> <p>224</p>

<p><i>Alien species are by definition taxa that are introduced outside of their natural range either intentionally or unintentionally by human agency.</i></p>	<p><i>Increasing movement of people/animals worldwide, increasing trade, climate change, global biodiversity loss (increases opportunity for establishment and spread of non-native species).</i></p>
218	217
<p><i>An organism that is only found in/confined to a particular location</i></p>	<p><i>An organism that is living in its home environment.</i></p>
220	219
<p><i>A non-native that has become a part of its new environment</i></p>	<p><i>To any species or race that does not occur naturally in an area.</i></p>
222	221
<p><i>A species that becomes so abundant after arrival that it damages biodiversity and often causes substantial economic or health problems is (INNS)</i></p>	<p><i>A non-native that has spread to become a dominant member of its new environment.</i></p>
224	223



*What are the three stages in invasion biology theory?*

225

*What makes an invasive species successful*

226

*What are the effects of invasive non-native species*

227

*Remember, not all invasive species are non-native. E.g.  
Bracken can invade heathland.*

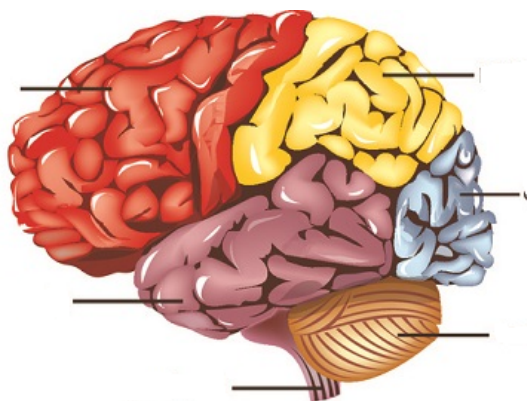
228

*Japanese knotweed was introduced from [redacted] in the  
[redacted] as an ornamental plant and cannon fodder. It has a  
dense leaf canopy, and is tolerant to [redacted],  
[redacted] and [redacted], growing at  
around one meter per month. It is hard to eradicate and small  
fragments (as small as [redacted]) grams can grow new  
plants. Both [redacted] and [redacted] control methods are  
used ([redacted] is best).*

229

*What is being done to tackle non-native invasive species?*

230



231

*What are the lobes in the brain?*

232

*They are r-strategists (grow quickly, produce many offspring, short generation time), good dispersion, generalists (highly adaptable, broad geographic range, broad diet)*

*Introduction, colonisation and establishment, invasive spread (only now is a species invasive).*

226

225

*Remember it.*

*They may invade adjacent geographic areas, displace native organisms, or produce hybrids with native species (an irreversible change in the genetic pool). They also change the food web and can cause hyperpredation.*

228

227

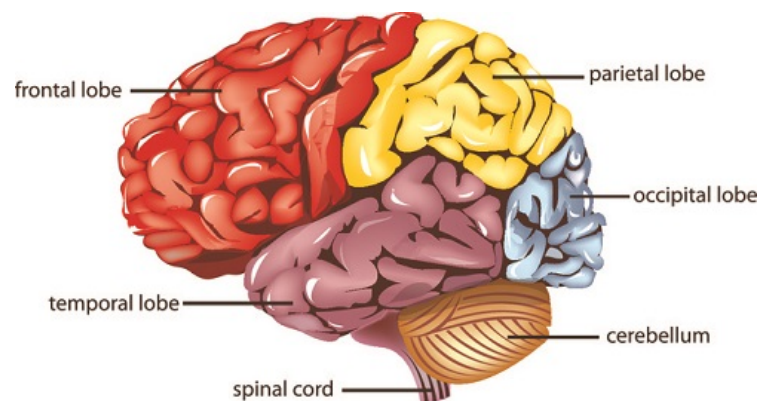
*Prevention (risk assessments), early detection (monitoring and rapid response), mitigation + eradication (kill the invaders), build public awareness.*

*Japanese knotweed was introduced from Japan in the 1800's as an ornamental plant and cannon fodder. It has a dense leaf canopy, and is tolerant to soil acidity, heavy metal contamination and pollution, growing at around one meter per month. It is hard to eradicate and small fragments (as small as 0.5 grams) can grow new plants. Both chemical and biological control methods are used (chemical is best).*

230

229

*Frontal, parietal, temporal, occipital*



232

231

What are the parts of the brain?

233

An obvious feature of the hemisphere of the brain is the [redacted]. The ridges are called [redacted] and the valleys are called [redacted].

234

The frontal lobe has the [redacted] and the [redacted]. The latter separates the frontal lobe from the rest of the brain. The [redacted] is located in the [redacted].

235

The frontal lobe is responsible for [redacted], [redacted] and [redacted].

236

What is a lesion?

237

The parietal lobe is located [redacted], and is responsible for [redacted] and [redacted].

238

The temporal lobe is responsible for [redacted], [redacted] and [redacted].

239

The occipital lobe is responsible for [redacted].

240

*An obvious feature of the hemisphere of the brain is the highly convoluted surface. The ridges are called gyri and the valleys are called sulci/fissures.*

234

*Cerebellum, brainstem, frontal lobe, parietal lobe, temporal lobe, occipital lobe.*

233

*The frontal lobe is responsible for movement, personality and planning.*

236

*The frontal lobe has the primary motor cortex and the central sulcus. The latter separates the frontal lobe from the rest of the brain. The primary motor cortex is located in the pre-central gyrus.*

235

*The parietal lobe is located behind the pre-central cortex, and is responsible for awareness of surroundings and stereognosis.*

238

*When the function of an organ is impaired*

237

*The occipital lobe is responsible for processing visual signals.*

240

*The temporal lobe is responsible for hearing, language and naming.*

239

The cerebellum [redacted].

241

The brainstem has [redacted]  
are here. This dictates things like [redacted] and  
[redacted].

242

What are the two different types of the somatic nervous system.

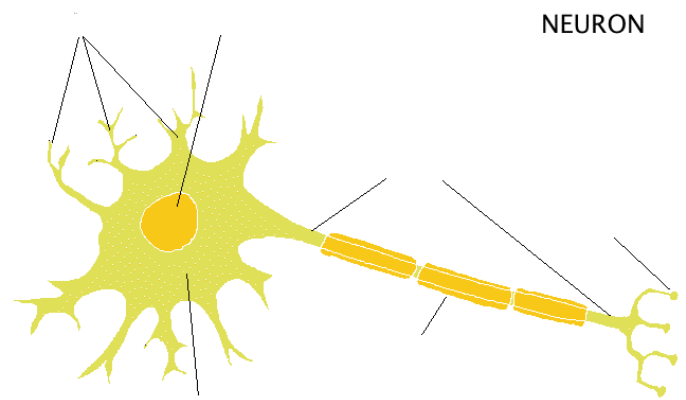
243

What makes up the Central Nervous System (CNS) )

244

What makes up the Peripheral Nervous System (PNS)

245



Myelin acts as an [redacted] and  
[redacted].

247

Axons that have a myelin sheath are called  
[redacted].

246

248

*The brainstem has cardiovascular and respiratory centres are here. This dictates things like heart beat speed and blood pressure.*

242

*The cerebellum coordinates movement and posture.*

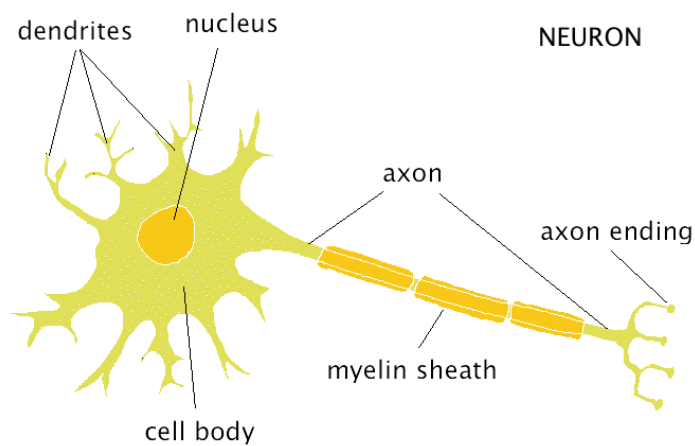
241

*The brain, brain stem and spinal chord*

*Central nervous system (CNS; brain, brain stem and spinal chord) and peripheral nervous system (includes the cranial and spinal nerves).*

244

243



246

*The brain, brain stem, spinal chord and cranial + spinal nerves*

245

*Axons that have a myelin sheath are called Myelinated axons.*

*Myelin acts as an insulator and speeds up transmission along the axon.*

248

247

The gaps between myelin sheathes are called

Affeent neurones go [ ] a receptor and efferent neurones is [ ] a receptor.

Name	Number of connections	Class
[ ]	1	Structural
Interneurone	[ ]	[ ]
[ ]	2	[ ]
Multipolar	[ ]	[ ]

249

250

Sense

Name

Pressure

Temperature

Light

Smell/taste

Pain/heat/tissue damage

‘Glia’ means [ ]. The job of the neuroglia is to [ ]. [ ] percent of the brain is neuroglia

Name	Where	Function
Schwann	[ ]	[ ] and [ ]
[ ]	Retina	
Oligodendrocyte	[ ]	
Astrocyte	[ ]	[ ]

251

252

Neuroglia are [ ] for the neurons.

The plasma membrane is a [ ] membrane that allows some things to move through and not others. Structures such as [ ] are on the membrane.

253

254

What is the resting membrane potential of a cell?

At rest, [ ] in a neurone. [ ] are closed, others are open.

255

256

Affeent neurones go from a receptor and efferent neurones is to a receptor.

Name	Number of connections	Class
Unipolar	1	Structural
Interneurone	1	Functional
Bipolar	2	Structural
Multipolar	n	Structural

The gaps between myelin sheathes are called Nodes of Ranvier

250

249

‘Glia’ means glue. The job of the neuroglia is to hold the neurones together. 95 percent of the brain is neuroglia

Name	Where	Function
Schwann	PNS	Create the myline sheath
Muller	Retina	Provide structural stability in retina
Oligodendrocyte	CNS	Create the myline sheath and maintain homeostasis
Astrocyte	Brain	Phagocytose (eat debris)

Sense	Name
Pressure	Mechanoreceptor
Temperature	Thermoreceptor
Light	Photoreceptor
Smell/taste	Chemoreceptor
Pain/heat/tissue damage	Nociceptor

252

251

The plasma membrane is a selectively permeable membrane that allows some things to move through and not others. Structures such as sodium and potassium channels are on the membrane.

Neuroglia are supporting cells for the neurons.

254

253

At rest, all of the sodium channels are closed in a neurone. Some potassium channels are closed, others are open.

-70mv

256

255



When a cell is stimulated, the  channels open, and  . This makes the cell cytoplasm .

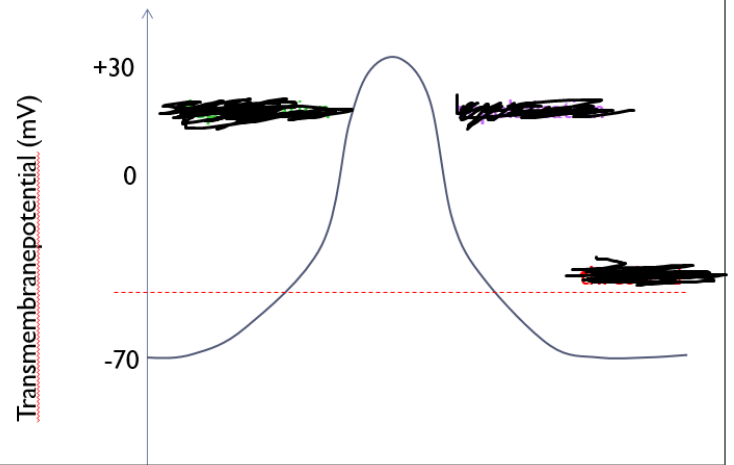
257

Define depolarisation

258

An action potential is  created by . It is an  event.

259



260

At rest, the neuron is at  and when an action potential occurs, then the cell  and goes to . A  pump gets rid of  in the cell to reset the charge (.

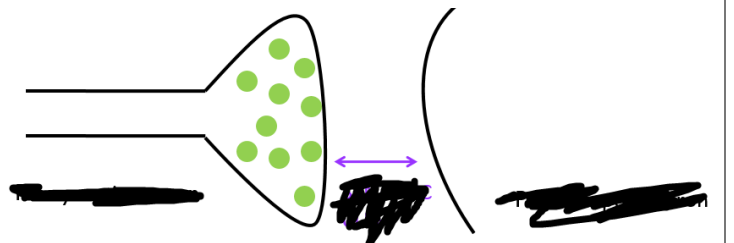
261

is when a stimulus is applied to neurone that causes it to go very negative.

262

Sensory pathways have  in them. They are called  neurones respectively.

263



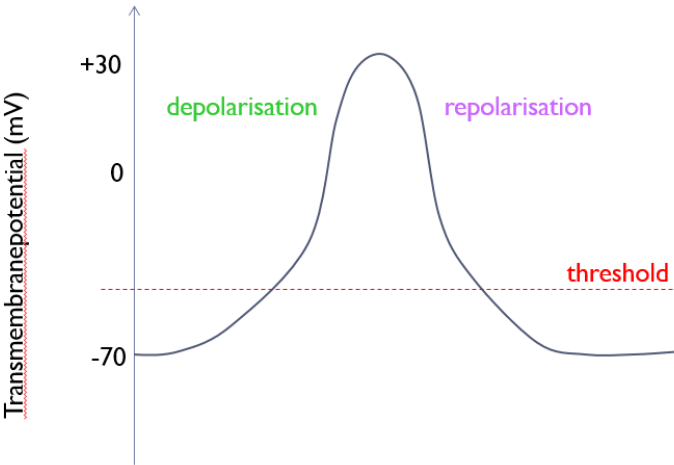
264

The inside of the cell has gone from -ve to +ve.

When a cell is stimulated, the sodium channels open, and the potassium channels close. This makes the cell cytoplasm less negative.

258

257



An action potential is an explosion of electrical activity created by a depolarising current. It is an all or nothing event.

259

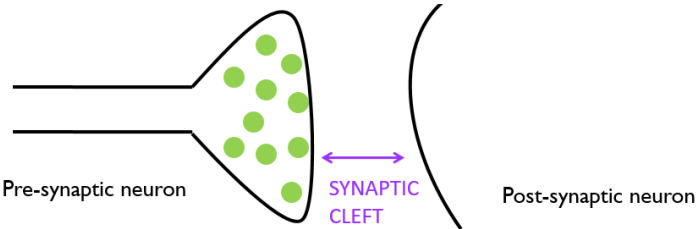
260

hyperpolarisation is when a stimulus is applied to neurone that causes it to go very negative.

At rest, the neuron is at -70mV and when an action potential occurs, then the cell depolarises and goes to 30mV. A sodium potassium pump gets rid of sodium in the cell to reset the charge (repolarisation).

262

261



Sensory pathways have three neurones in them. They are called first, second and third order neurones respectively.

264

263

\_\_\_\_\_ reaches axon terminal. \_\_\_\_\_ fuse with the pre-synaptic membrane. \_\_\_\_\_ are released from vesicles, they travel in the \_\_\_\_\_ to bind with receptors on \_\_\_\_\_. This works using the \_\_\_\_\_ model.

265

A seizure is \_\_\_\_\_, and is a \_\_\_\_\_ event resulting from discharge of cerebral neurone. Epilepsy is the \_\_\_\_\_ to have such seizures.

266

An \_\_\_\_\_ that has \_\_\_\_\_ is called \_\_\_\_\_, and indicates \_\_\_\_\_.

267

What are the three types of seizure?

268

A tonic clonic seizure (\_\_\_\_\_) is a \_\_\_\_\_, before \_\_\_\_\_.

269

An absence seizure (\_\_\_\_\_) is \_\_\_\_\_.

270

A myoclonic seizure is \_\_\_\_\_.

271

Types of generalised seizures include \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ seizures.

272

*A seizure is the same as a convulsion, and is a transient abnormal event resulting from discharge of cerebral neurone. Epilepsy is the continued tendency to have such seizures.*

266

*Action potential reaches axon terminal. Vesicles fuse with the pre-synaptic membrane. Neurotransmitters are released from vesicles, they travel in the synaptic cleft to bind with receptors on post-synaptic neuron. This works using the Lock and Key model.*

265

*Generalised (all over the brain), partial (one part of the brain), partial with secondary generalisation (initially partial, then moves).*

268

*An electroencephalogram that has an explosion in the middle is called spike and wave, and indicates transient abnormal discharge.*

267

*An absence seizure (petit mal) is when the patient goes blank for a few seconds.*

270

*A tonic clonic seizure (grand mal) is a movie style seizure where the body jerks, the mouth froths etc, before muscle paralysis occurs*

269

*Types of generalised seizures include tonic clonic, absence and myoclonic seizures*

272

*A myoclonic seizure is when a muscle or muscle group twitches.*

271

<p>Partial seizures include [redacted], [redacted] ([redacted]) and [redacted].</p> <p>273</p>	<p>Induced Aura is when [redacted].</p> <p>274</p>
<p>Jacksonian seizure is in the [redacted] ([redacted]), [redacted] progresses from [redacted] to [redacted].</p> <p>275</p>	<p>Todd's paralysis is [redacted] after a seizure.</p> <p>276</p>
<p>Causes of seizures include [redacted] such as [redacted], [redacted] ([redacted]) or a [redacted] (where the clingfilm-like lining of the brain is damaged). Cerebrovascular causes can also contribute such as when [redacted]. Other causes include [redacted], [redacted], [redacted] and [redacted].</p> <p>277</p>	<p>How is a seizure diagnosed and treated?</p> <p>278</p>
<p>What is diazepam</p> <p>279</p>	<p>Epileptic people must not have a fit for [redacted] in order to [redacted] and must always [redacted], though [redacted].</p> <p>280</p>

*Induced Aura is when in some patients, they can tell if they're going to have a seizure.*

274

*Partial seizures include induced aura, jacksonian seizure (motor cortex) and Todd's paralysis.*

273

*Todd's paralysis is limpness after a seizure.*

276

*Jacksonian seizure is in the motor cortex (frontal lobe), twitching progresses from one part of the body to another, stopping in-between*

275

*Diagnoses wise, alternate causes are ruled out with eyewitness accounts and an EEG is taken. Treatment wise, patients should not be restrained since they could hurt themselves/others, and medication such as diazepam could be taken.*

278

*Causes of seizures include trauma to the brain such as penetrating brain injury, bruised brain (cerebral contusion) or a dural tear (where the clingfilm-like lining of the brain is damaged). Cerebrovascular causes can also contribute such as when part of the brain dies due to stroke. Other causes include alcohol, hypoglycaemia, high fever and brain tumors.*

277

*Epileptic people must not have a fit for ten years in order to drive trucks, planes, boats etc and must always inform the DVLA, though most people have normal lives.*

280

*A muscle suppressant given to fitting people. Too much can inhibit breathing.*

279

<p>█ person per █ people are affected in the UK by parkinsons disease.</p> <p>281</p>	<p>The █ are regions within the brain that are responsible for █, █ and emotive aspects of movements. This shrinks in █ patients. █ bodies are often found within nerve cells of these patients.</p> <p>282</p>
<p>Parkinson's patients will often have █, █, █, █ and █.</p> <p>283</p>	<p>Diagnosis for parkinson's is █, and patients typically live for █ years from diagnosis. Death is usually caused by █. There are treatments available that produce striking improvements at first, █ of the disease (█ agents).</p> <p>284</p>
<p>Define dementia.</p> <p>285</p>	<p>How many people in the UK have dementia?</p> <p>286</p>
<p>List the causes of dementia. Give a factor that may help prevent it.</p> <p>287</p>	<p>Alcohol is a █ depressant, and inhibits the █ channels in the brain, leading to █. This leads to a reduction in █, █, █ and █.</p> <p>288</p>

*The basal ganglia are regions within the brain that are responsible for learned movements, advanced planning for later movements and emotive aspects of movements. This shrinks in parkinson's patients. Lewy bodies are often found within nerve cells of these patients.*

*1 person per 500 people are affected in the UK by parkinsons disease.*

282

281

*Diagnosis for parkinson's is clinical, and patients typically live for 10-15 years from diagnosis. Death is usually caused by bhronchopneumonia. There are treatments available that produce striking improvements at first, but don't alter the course of the disease (dopamine agents).*

*Parkinson's patients will often have a stooped posture, a shuffling gait, poor arm swing, tremors and rigidity, a mask like face and monotonous speech.*

284

283

*520,000*

*A set of symptoms that include memory loss, and difficulties with thinking, problem solving or language.*

286

285

*Alcohol is a CNS depressant, and inhibits the sodium and calcium channels in the brain, leading to fewer action potentials. This leads to a reduction in social & behavioural restraints, thought processes, fine discrimination. judgement and motor functions.*

*Degenerative; Alzheimers, multisystem atrophy, huntingtons, lewy body dementia. Infective; CJD (mad cow), AIDS, syphilis. Metabolic; Vitamin B12 deficiency, folate deficiency, hypoglycemia. Alcohol/drugs. Tumors. The mediterranean diet has been correlated with a reduced risk of the disease.*

288

287



*List the effects of morphine*

289

*How does morphine work?*

290

*Caffine (Trimethylxanthine) is in many places such as in tea, coffee, chocolate etc. It causes [REDACTED], but [REDACTED], and can cause [REDACTED] and [REDACTED]. The affects are seen within [REDACTED] and last for [REDACTED]. It works by interfering with [REDACTED].*

291

*Adenosine is an [REDACTED] (it [REDACTED]). Caffine [REDACTED], causing increased activity of [REDACTED].*

292

*Viruses are [REDACTED] that [REDACTED]. They are often referred to as [REDACTED], and consist of [REDACTED] surrounded by [REDACTED]. They are classified by the type of [REDACTED], how they [REDACTED] and if they are [REDACTED] or [REDACTED].*

293

*Bacteria are [REDACTED] microorganisms, since they have a [REDACTED] and no [REDACTED].*

294

*Fungi are [REDACTED] microorganisms with [REDACTED], and are sized at anywhere from micrometers to cenitmeters. Some are [REDACTED] and others are [REDACTED] (i.e. shrooms).*

295

*Protozoa are [REDACTED] that are [REDACTED]. Helminths are also [REDACTED], but are also [REDACTED].*

296

<p><i>It binds to receptors on neurones, and opens the potassium channels. This causes hyperpolarisation as potassium leaves the cell (decreasing the chance of action potentials). Morphine also inhibits neurotransmitter release. Overall the effect is inhibitory.</i></p>	<p><i>Pain relief, euphoria, itching (histamines are released), small pupils, constipation (decreased motility of the gut), nausea and vomiting, breathing problems (can be remedied with other drugs).</i></p>
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290

289

<p><i>Adenosine is an inhibitory neurotransmitter (it promotes sleep). Caffeine blocks its action, causing increased activity of dopamine and glutamate.</i></p>	<p><i>Caffeine (Trimethylxanthine) is in many places such as in tea, coffee, chocolate etc. It causes alertness, but decreases fine motor coordination, and can cause insomnia and headaches. The affects are seen within 15 minutes and last for several hours. It works by interfering with adenosine.</i></p>
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292

291

<p><i>Bacteria are prokaryotic microorganisms, since they have a cell wall and no distinct nucleus.</i></p>	<p><i>Viruses are genetic elements that replicate inside cells. They are often referred to as sub-cellular parasites, and consist of nucleic acid surrounded by protein. They are classified by the type of nucleic acid, how they replicate and if they are single or double stranded.</i></p>
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294

293

<p><i>Protozoa are parasitic infections that are unicellular, lack cell walls and usually move around (are motile). Helminths are also parasitic infections and motile, but are also multicellular and macroscopic.</i></p>	<p><i>Fungi are eukaryotic microorganisms with rigid cell walls, and are sized at anywhere from micrometers to centimeters. Some are unicellular and others are filamentous (i.e. shrooms).</i></p>
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296

295

Emerging and re-emerging infectious diseases today include infections that are [redacted], unrecognised infections appearing in [redacted], old infections becoming [redacted] and diseases thought [redacted].

297

Antibiotics work in a variety of different ways, such as by [redacted] (penicillin) or [redacted] (tetracycline, enthomycin).

298

Bacteria can become drug resistant by [redacted], [redacted], [redacted], or [redacted].  
One antibiotic can become ineffective [redacted].

299

[redacted] (HAI's) are a big issue now. They are not always preventable since some patients are [redacted] or [redacted].

300

MRSA is resistant to most antibiotics. It was first reported in [redacted], and is a major problem now. At its peak there were [redacted] MRSA blood infections per year, but now there are [redacted].

301

Are viruses life?

302

Flu and ebola are [redacted] strand group [redacted] viruses

303

Why is influenza so prevalent?

304

*Antibiotics work in a variety of different ways, such as by inhibiting cell wall formation (penicillin) or protein synthesis (tetracycline, entromycin).*

298

*Emerging and re-emerging infectious diseases today include infections that are spreading to new populations, unrecognised infections appearing in areas with habitat change (deforestation), old infections becoming resistant to treatment (drug resistance) and diseases thought to have been eradicated.*

297

*Hospital acquired infections (HAI's) are a big issue now. They are not always preventable since some patients are immunocompromised or already carry latent microorganisms.*

300

*Bacteria can become drug resistant by becoming impermeable to the drug, pumping out the drug, modifying the target of the drug, or inactivating the drug. One antibiotic can become ineffective by several different mechanisms.*

299

*No, since they have to be inside another cell to replicate.*

*MRSA is resistant to most antibiotics. It was first reported in 1961, and is a major problem now. At its peak there were 7000 MRSA blood infections per year, but now there are less than 1000.*

302

301

*Since it has so many hosts that it can infect (i.e. different species)*

*Flu and ebola are negative strand group 5 viruses*

304

303

<p><i>How many types of flu viruses are there? Which is the main human one?</i></p> <p>305</p>	<p><i>What is the structure of the influenza virus?</i></p> <p>306</p>
<p><i>Where does influenza infect in the mammal?</i></p> <p>307</p>	<p><i>Influenza binds to [REDACTED] on the cell. The virus has two proteins, [REDACTED] (cell entry) and [REDACTED] (cell exit).</i></p> <p>308</p>
<p><i>[REDACTED] are messaging molecules for the immune system that are released by cells infected with a virus.</i></p> <p>309</p>	<p><i>Why is influenza so prone to variation?</i></p> <p>310</p>
<p><i>How often are there flu epidemics?</i></p> <p>311</p>	<p><i>There are [REDACTED] subtypes of H-influenza and [REDACTED] subtypes of N-influenza.</i></p> <p>312</p>

*Negative stranded RNA core surrounded by a protein and lipid envelope.*

306

*Three; A, B and C. A is the one that is the main human pathogen.*

305

*Influenza binds to surface proteins on the cell. The virus has two proteins, H (cell entry) and N (cell exit).*

308

*The respiratory tract. The lower down, the worse the symptoms.*

307

*Since the RNA of viruses lacks proof reading, so that the H and N antigens change ("antigenic drift"). This is why there are new flu vaccines produced every year.*

310

*Cytokines are messaging molecules for the immune system that are released by cells infected with a virus.*

309

*There are 18 subtypes of H-influenza and 11 subtypes of N-influenza.*

312

*There is a localised epidemic, every 2-3 years.*

311

*How often are there influenza pandemics?*

313

*Give an example of a flu pandemic*

314

*Why are young healthy people vulnerable to flu?*

315

*Talk about hong kong bird flu.*

316

*What drug treatments are available for flu?*

317

*There is lots of drug resistance for anti-virals for flu because*  
*[redacted].*

318

*Ebola virus has a [redacted] shape under the electron microscope. It has [redacted] of RNA, and the natural host is [redacted]. It is spread by [redacted].*

319

*What is the mortality rate of ebola*

320

*Spanish flu (1918, 40-50 million dead), Asian flu (1957, 2 million dead), Hong Kong flu (1968, 1 million dead), Russian flu (1977).*

*Every ten to forty years?*

314

313

*Hong Kong Bird flu (1997, H5N1) went from birds to humans. Increased pathogenesis, efficient viral replication and cytokine storm. Mortality rate was about 55%. Probably caught via bird faeces.*

*Since they have a very good immune system, and there will be a large response, which can cause death (lots of fever etc). This is called a cytokine storm.*

316

315

*There is lots of drug resistance for anti-virals for flu because the virus mutates so rapidly.*

*Antiviral drugs such as neuraminidase inhibitors (tamiflu, relenza), M2 inhibitors such as flumadine. All drugs experience resistance. New treatments are looking at blocking cell entry and better regulating the immune response.*

318

317

*30-50 percent.*

*Ebola virus has a shepherd's crook shape under the electron microscope. It has one long strand of RNA, and the natural host is probably fruit bats. It is spread by bodily contact with humans.*

320

319



<p><i>Symptoms of ebola?</i></p> <p>321</p>	<p><i>Ebola infects [REDACTED] cells, which then trigger an immune response, and usually release a cytokine called [REDACTED], which acts as a warning system for nearby cells.</i></p> <p><i>Ebola lets [REDACTED] be produced, but stops the immune cells working, which means that cells respond to the cytokines and die/slow down protein synthesis etc.</i></p> <p>322</p>
<p><i>What are the ebola drugs?</i></p> <p>323</p>	<p><i>What diagnostic tests are there for ebola?</i></p> <p>324</p>
<p><i>Ebola has a biosafety level of [REDACTED], where there is a high risk of transmission through the air, and can cause severe and fatal disease where there is no vaccine.</i></p> <p>325</p>	<p><i>Why is it unlikely that ebola will become airborne?</i></p> <p>326</p>

*Ebola infects immune system cells, which then trigger an immune response, and usually release a cytokine called interferon, which acts as a warning system for nearby cells. Ebola lets interferon be produced, but stops the immune cells working, which means that cells respond to the cytokines and die/slow down protein synthesis etc.*

322

*Asymptomatic for 2-21 days. and not infectious for that time. Abrupt manifestation after that, fever, chills, muscle pain and other infections. Then more (nausea, vomiting, headache etc). After that, haemorrhagic manifestations (coughing up blood etc) in 30-50 percent of patients. Post infection complications.*

321

*Can't detect antibody response for ebola sometimes since the immune system is partially deactivated, and also that people die before a measurable antibody response is detected (and patients often die before then). Electron microscopes can be used to identify the virus.*

324

*Most support blood pressure and fluids. There are several unapproved treatments but these can only be used with patient consent.*

323

*There has been no virus that has been transmitted by bodily fluids that has mutated to become transmitted through the air.*

326

*Ebola has a biosafety level of 4, where there is a high risk of transmission through the air, and can cause severe and fatal disease where there is no vaccine.*

325