

BLITZING BIOLOGY 12

Sample Answers



Katrina Garner

BLITZING
PUBLICATIONS

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About Blitzing Biology 12

Blitzing Biology 12 is a student activity book, which contains activities that seek to address the content and skills outcomes for the *Biology Stage 6 Syllabus (2017)* – published by NESA (NSW Education Standards Authority).

To find out more about *Blitzing Biology 12* or to order a copy, please visit:

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Disclaimers

These sample answers are provided as a tool to assist teachers and students.

These answers are designed as a guide only. Please note that many of the activities in *Blitzing Biology* have more than one possible correct answer.

Every effort has been made to provide error-free answers. However, no one is perfect. Please email the author if you would like to advise of any correction(s) needed for future editions: katrina@blitzingbiology.com.au

Revisions to these answers are regularly made. The latest version of these answers is available on the Blitzing Biology website: www.blitzingbiology.com.au

Module 5: Heredity

Chapter 1

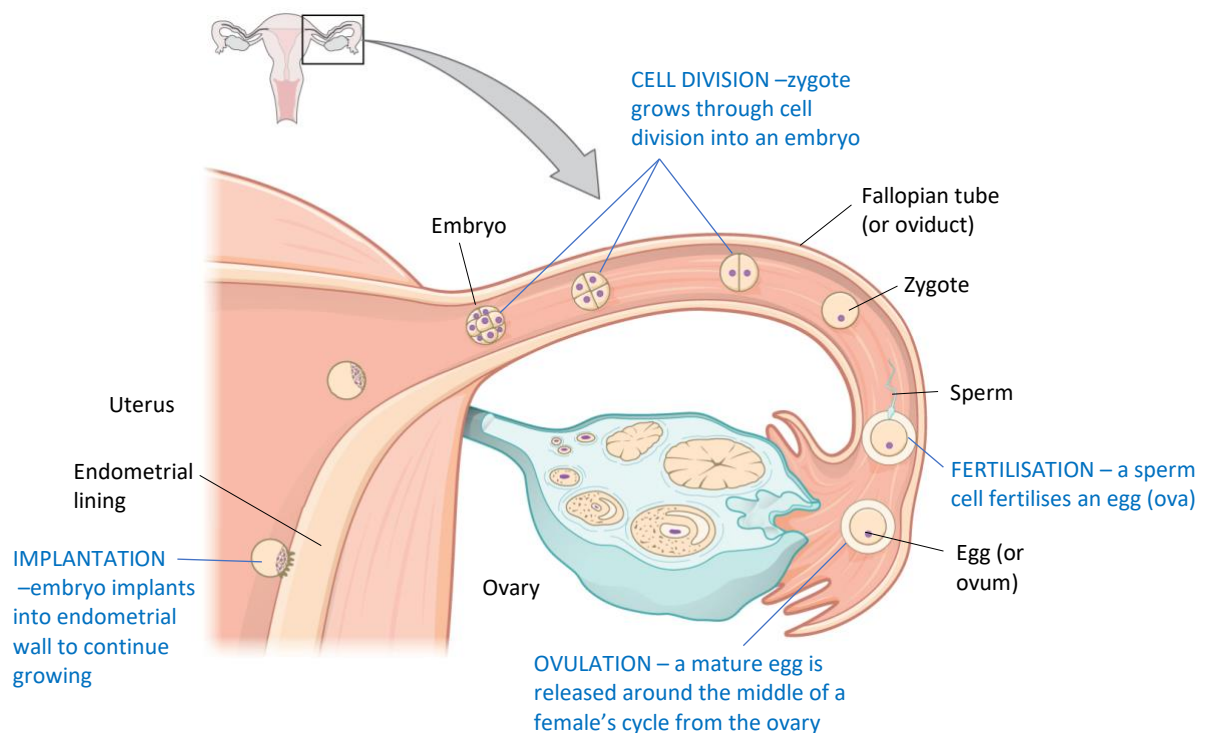
Section	Activity	Sample answers														
1.1	3	<ul style="list-style-type: none"> • spans • individual • continue • reproduce • methods • sexual • one • identical • two • genetic • variation • either • asexual 														
	4	1:3, 2:5, 3:1, 4:4, 5:2														
	5	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><i>Sexual reproduction</i></th> <th style="text-align: center;"><i>Asexual reproduction</i></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">High</td> <td style="text-align: center;">Low</td> </tr> <tr> <td style="text-align: center;">Longer</td> <td style="text-align: center;">Shorter</td> </tr> <tr> <td style="text-align: center;">Yes</td> <td style="text-align: center;">No</td> </tr> <tr> <td style="text-align: center;">Many possible answers, e.g. humans, etc</td> <td style="text-align: center;">Many possible answers, e.g. bacteria, etc</td> </tr> </tbody> </table>	<i>Sexual reproduction</i>	<i>Asexual reproduction</i>	2	1	High	Low	Longer	Shorter	Yes	No	Many possible answers, e.g. humans, etc	Many possible answers, e.g. bacteria, etc		
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Many possible answers, e.g. humans, etc	Many possible answers, e.g. bacteria, etc															
1.2	1	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">a) Gamete</td> <td style="width: 50%;">h) 23</td> </tr> <tr> <td>b) Egg and ovum</td> <td>i) 46</td> </tr> <tr> <td>c) Sperm</td> <td>j) Diploid</td> </tr> <tr> <td>d) Haploid</td> <td>k) 12</td> </tr> <tr> <td>e) 50%</td> <td>l) 24</td> </tr> <tr> <td>f) 100%</td> <td>m) Meiosis</td> </tr> <tr> <td>g) 23</td> <td></td> </tr> </table>	a) Gamete	h) 23	b) Egg and ovum	i) 46	c) Sperm	j) Diploid	d) Haploid	k) 12	e) 50%	l) 24	f) 100%	m) Meiosis	g) 23	
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e) 50%	l) 24															
f) 100%	m) Meiosis															
g) 23																
2	Fertilisation allows the genetic material from two parents to combine to form offspring. Fertilisation also allows two haploid gametes to combine to create a diploid cell, thus restoring the original number of chromosomes and ensuring that the offspring have a full set of chromosomes.															
1.3	1	<ul style="list-style-type: none"> a) A sex cell that is haploid, e.g. eggs (ova) or sperm. b) When a sperm cell combines with an egg (ovum) cell. c) When eggs (ova) and sperm are combined inside the female body. d) When eggs (ova) and sperm are combined outside the female body. e) A fertilised egg (a fertilised ovum). 														
	2	<ul style="list-style-type: none"> a) External b) Internal c) Internal d) Internal e) External 														

Chapter 1 [continued]

Section	Activity	Sample answers													
1.3	3	<p>a) Water is more readily available in aquatic ecosystems to prevent the gametes drying out, as can occur in terrestrial ecosystems.</p> <p>b) They increase the chance of eggs and sperm being released near each other at the same time, so that fertilisation can occur.</p> <p>c) Many gametes will not survive due to predators and drying out. So this increases the chance of some gametes surviving until fertilisation occurs.</p> <p>d) Zygotes produced by internal fertilisation are more likely to survive until birth than those produced by external fertilisation, as the eggshell or mother's body protects them from predators and from drying out.</p>													
	4	<table border="1"> <thead> <tr> <th><i>Internal fertilisation</i></th> <th><i>External fertilisation</i></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>Low</td> </tr> <tr> <td>Inside the mother or in an egg</td> <td>In the external environment</td> </tr> <tr> <td>High</td> <td>Low</td> </tr> <tr> <td>Few</td> <td>Many</td> </tr> <tr> <td>Terrestrial / dry</td> <td>Aquatic / moist,</td> </tr> <tr> <td>Many possible answers, e.g. mammals</td> <td>Many possible answers, e.g. fishes</td> </tr> </tbody> </table>	<i>Internal fertilisation</i>	<i>External fertilisation</i>	High	Low	Inside the mother or in an egg	In the external environment	High	Low	Few	Many	Terrestrial / dry	Aquatic / moist,	Many possible answers, e.g. mammals
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1.4	1	<ul style="list-style-type: none"> • blooded • hair • milk • sexually • internal • birth • dogs • inside • wastes • developed • kangaroos • pouch • eggs • grow • echidna • mammals 													
	2	<p>a) Monotremes</p> <p>b) Placental mammals and marsupial mammals</p> <p>c) (1) To supply nutrients and oxygen. (2) To remove wastes.</p> <p>d) Placental mammals</p> <p>e) They continue developing after birth.</p> <p>f) To protect the offspring and allow continued development.</p> <p>g) Internal</p>													
	4	<p>a) Internal development provides protection and essential nutrients for the developing offspring. This increases their chance of survival and so allows their species to continue. However, parental care involves considerable energy and time, which can shorten the parent's lifespan or result in less opportunity for mating and producing more offspring.</p> <p>b) The placenta provides nutrients and oxygen to the baby and removes wastes. The movement of these through the umbilical cord is two-way as nutrients and oxygen move into the baby, while the wastes move out.</p> <p>c) Mammalian offspring receive nutrition from their mother after birth and are often born without being fully developed. This dependency makes it unlikely that they would want to, or be capable of, eating their mother.</p>													

Chapter 1 [continued]

Section	Activity	Sample answers
1.6	1	j) When a growing follicle produces a high level of oestrogen, feedback stimulates the hypothalamus and pituitary to reduce the production of GnRH, FSH and LH.
	2	a) FSH and LH b) Oestrogen and progesterone c) FSH and LH d) Ovulation e) The follicle f) The corpus luteum g) Both oestrogen and progesterone decrease to low levels by Day 28
	3	• LH • ovulation • corpus • progesterone • hypothalamus • gland • 5 • ovarian • uterus • egg
1.7	2	From top to bottom: 4, 3, 2, 1, 6, 5
	3	The diagram below shows an example of how you might have labelled the diagram.



Chapter 1 [continued]

Section	Activity	Sample answers
1.7	4	<p>a) By cell division (mitosis)</p> <p>b) About one week</p> <p>c) The inner cell mass</p> <p>d) The trophoblast</p> <p>e) Into the endometrium (uterus lining)</p> <p>f) HCG</p> <p>g) HCG is responsible for sustaining the secretion of progesterone and oestrogen by the corpus luteum. These hormones are essential for maintaining the uterus lining to support embryonic development.</p> <p>h) HCG is a hormone produced by a blastocyst (a young embryo) that has implanted into the uterine wall. This is an early stage of pregnancy.</p>
1.8	2	<p>a) F</p> <p>b) T</p> <p>c) T</p> <p>d) F</p> <p>e) T</p> <p>f) T</p> <p>g) F</p> <p>h) T</p> <p>i) T</p>
	3	<p>a) HCG rapidly increases in first trimester, then decreases during the second trimester. HCG remains at a low level in the third trimester. Oestrogen and progesterone both increase steadily in the first and second trimester and more rapidly during the third trimester. Progesterone decreases slightly prior to birth.</p> <p>b) The progesterone and oestrogen produced due to HCG maintaining the corpus luteum and later on due to the placenta help to maintain the uterus lining. This prevents menstruation or ovulation occurring.</p> <p>c) Synthetic oxytocin works in the same way as the oxytocin produced naturally during labour by the mother and baby. It helps to trigger and maintain labour by causing uterine contractions that help push the baby towards the cervix.</p> <p>d) Until birth occurs, the cervix will continue to have pressure from the baby's head. This pressure triggers oxytocin to be released, which in turn causes contractions that push the baby towards the cervix.</p>

Chapter 1 [continued]

Section	Activity	Sample answers
1.8	4	<pre> graph TD A[Offspring sucks on mother's nipple] --> B[Nerve receptor is triggered in nipple, which signals hypothalamus in brain] B --> C[Hypothalamus stimulates anterior pituitary gland to produce oxytocin and prolactin] C --> D[Oxytocin stimulates release of milk from storage] C --> E[Prolactin stimulates production of more milk] </pre>
	5	<ul style="list-style-type: none"> • primates • mammals • cycle • thickening • reabsorb • changes • active • oestrous • body • heat • season • length • dogs • female

Chapter 2

Section	Activity	Sample answers
2.1	1	<ul style="list-style-type: none"> a) Each flat worm has both male and female reproductive organs. b) It is less likely to be injured by the other worm's penises. It also does not have the burden of pregnancy. c) The worm that becomes the mother must work longer and harder to find food to cater for both its own and the offspring's energy needs.
	2	<ul style="list-style-type: none"> a) Clown fish are hermaphrodites as they have both male and female reproductive organs. They can change their sex sequentially, with a male life stage initially, followed by a female then a male life stage, and so on. b) No – each clown fish colony only has only one female at a given time. If that female dies, the most dominant male replaces her. Less dominant male clown fish can live their entire lives as males.
2.2	2	<ul style="list-style-type: none"> 1) A 2) B 3) C 4) C 5) A 6) C
	3	<ul style="list-style-type: none"> a) F b) T c) T d) F e) T
	4	<p>No – many species that are capable of reproducing asexually by parthenogenesis can also reproduce sexually (if a mate is available). [Note: A female of such a species can reproduce by parthenogenesis even if she has previously reproduced sexually.]</p>
2.3	1	<ul style="list-style-type: none"> a) Over 300,000 b) Gymnosperms and angiosperms c) No d) Yes e) No (they use spores) f) Xylem and phloem g) Vegetative propagation h) Cuttings and grafting i) Ferns have vascular tissue, but do not have seeds. j) Many possible answers, e.g. cycads and conifers (such as pine trees, cypresses, spruce, fir), ginkgo.

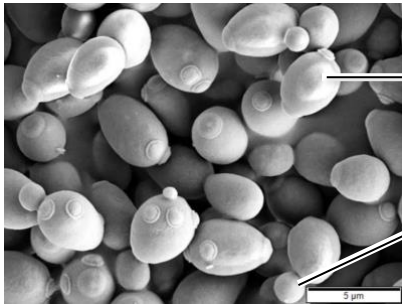
Chapter 2 [continued]

Section	Activity	Sample answers
2.4	2	<ul style="list-style-type: none"> • angiosperms • female • male • reproductive • top • pollen • sperm • bees • sweet • parts • ovary • sticky • fertilised • fruit
	3	<p><i>Other labels should include:</i></p> <ul style="list-style-type: none"> • Ovary – where eggs get fertilised; forms fruit • Stigma – sticky to help pollen stick to it • Style – a stalk (supporting the stigma) • Carpel – female reproductive parts of a plant • Stamen – male reproductive parts of a plant • Filament – a stalk (supporting the anther) • Anther – produces pollen
	4	<ul style="list-style-type: none"> a) 6 b) 1 c) 5 d) 3 e) Pollen
	5	<i>From top to bottom: 6, 3, 1, 2, 4, 5</i>
	6	<ul style="list-style-type: none"> a) Fertilisation involves the sperm cell dividing to form two sperm cells and each has a role in fertilisation. One fertilises the egg to form the zygote, while the other combines with the polar nuclei to form the endosperm. b) Ovary c) The seeds of an edible fruit pass through the digestive system of animals that eat the fruit and so can travel a distance away from the plant. However, non-edible fruits rely on wind or water or sticking to an animal to be dispersed.
	8	<ul style="list-style-type: none"> a) The transfer of pollen from one plant's anther to the stigma of another plant within the same species. b) It increases genetic variation in offspring. c) Two d) It reduces the likelihood of self-pollination occurring.
	10	<p>1:2, 2:3, 3:1, 4:7, 5:6, 6:5, 7:4</p> <p><i>i.e. the definitions from top to bottom are:</i></p> <ul style="list-style-type: none"> • anther • stamen • carpel • petals • ovule • ovary • stigma

Chapter 2 [continued]

Section	Activity	Sample answers
2.5	1	<p>a) Cones</p> <p>b) Female cones are rounder in shape, contain an ovule and grow in the upper branches. Male cones are narrower in shape, produce pollen and grow in the lower branches.</p> <p>c) Pollen from a male cone is blown by wind to a scale on a female cone. A pollen tube forms and allows the sperm cells to reach the ovule, where they can fertilise the ovule to form a seed.</p> <p>d) (i) Diploid ($2n$) (ii) Haploid ($1n$) (iii) Diploid ($2n$)</p> <p>e) (i) Male (ii) Female</p> <p>f) • pollen: (i) (= a male cone) • seeds when fertilised: (ii) (= a female cone)</p>
	2	<p>a) Ferns and mosses</p> <p>b) Haploid</p> <p>c) 2</p> <p>d) A multicellular, haploid plant structure that can produce gametes.</p> <p>e) A multicellular, diploid plant structure that can produce spores.</p> <p>f) Haploid</p> <p>g) Haploid</p> <p>h) Formation of the zygote (to make the sporophyte)</p> <p>i) Spores</p>
2.7	2	<p>a) Eukaryotic</p> <p>b) They can be either unicellular or multicellular.</p> <p>c) They secrete enzymes that enable them to absorb nutrients from the environment.</p> <p>d) <i>Multiple correct answers are possible, e.g.</i> Fungi cause diseases such as athlete's foot and ringworm.</p> <p>e) <i>Multiple correct answers are possible, e.g.</i></p> <ul style="list-style-type: none"> • Some fungi are a food for humans, e.g. mushrooms. • Fungi such as yeast are used in bread baking and brewing alcoholic beverages. • Some fungi produce antibiotics, e.g. penicillin. • Some fungi are essential to the nutrient cycle. <p>f) A cell wall</p> <p>g) Animals</p> <p>h) Both</p> <p>i) Tiny, branching filaments found in multicellular fungi.</p> <p>j) Spores enable most multicellular fungi to reproduce.</p>

Chapter 2 [continued]

Section	Activity	Sample answers
2.7	3	<p>a) Animals cells. Fungal and animal cells are both eukaryotic cells with a membrane-bound nucleus and mitochondria. Most fungi are multicellular and so have specialised cells, as do most animals.</p> <p>b) Fungal spores are very light and easily dispersed by breezes into the kitchen where they can colonise on foods.</p> <p>c) The spores bursting out of the puffball can be dispersed by wind to a new location where they can germinate into a new puffball fungus.</p> <p>d) The cells of the new fungus formed are also haploid cells and are genetically identical to the parent cell.</p>
	4	A fungal mycelium has many branching structures that grow outward in a circle as it expands underground as they seek nutrients. As this occurs, the fruiting bodies form in a circular shape above ground on the outer parts. The grass above the leading edge of the fungal mycelium becomes greener due to the fungus enriching the soil below with nutrients.
	5	<p>The spores allow <i>Penicillium</i> fungi to reproduce and so assist in the survival of their species.</p> <p>[Note: Spores also assist in their dispersal and so allow them to expand their distribution and colonise new environments, which assists in species survival.]</p>
2.8	1	<p>a) Yeasts</p> <p>b) Asexually by budding</p> <p>c) The DNA replicates.</p> <p>d) A birth scar</p> <p>e) A bud scar</p> <p>f) Yes</p> <p>g) Separation of the cytoplasm to form two separate cells.</p>
	2	<p>a) Answer is on diagram below.</p> <p>b) Answer is on diagram below.</p> <p>Note: There are multiple possible locations that can be similarly labelled as below, e.g.</p>  <p>c) 4-5 μm (approximately)</p>

Chapter 2 [continued]

Section	Activity	Sample answers
2.9	1	a) Binary fission b) Bacteria and archaea c) It is duplicated. d) Asexually
	2	<ul style="list-style-type: none"> • reproduce • fission • one • circular • origin • replicate • copy • end • duplicated • two • cytokinesis • centre • wall • opposite • daughter • identical • variations
	3	a) <i>There are multiple possible answers, including:</i> <ul style="list-style-type: none"> • They are both forms of asexual reproduction. • They both occur in unicellular organisms. • They both involve one parent cell and the formation of two daughter cells. • They both result in genetically identical daughter cells. b) <i>There are multiple possible answers, including:</i> <ul style="list-style-type: none"> • They occur in different organisms. • Binary fission involves cytokinesis and the formation of daughter cells that are the same size as each other, whereas budding creates daughter cells of unequal sizes. • Binary fission does not involve nuclear division as there is no nucleus, whereas budding does involve nuclear division. • Budding causes birth/bud scars on cells, while binary fission does not. b) Cytokinesis is essential to separate the cytoplasm into the new daughter cells and to ensure that each of these daughter cells has a copy of the chromosome.
	4	a) Growth phase b) Death phase c) Lag phase and stationary phase d) Growth phase e) Death phase f) <ul style="list-style-type: none"> • nutrient availability • a build-up of waste products [Note: Other factors such as temperature, pH, water availability, substrate concentration, presence of gases (e.g. oxygen), etc, also affect the growth of bacteria.]

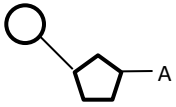
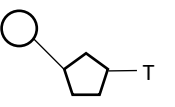
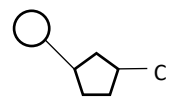
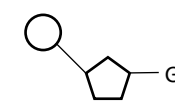


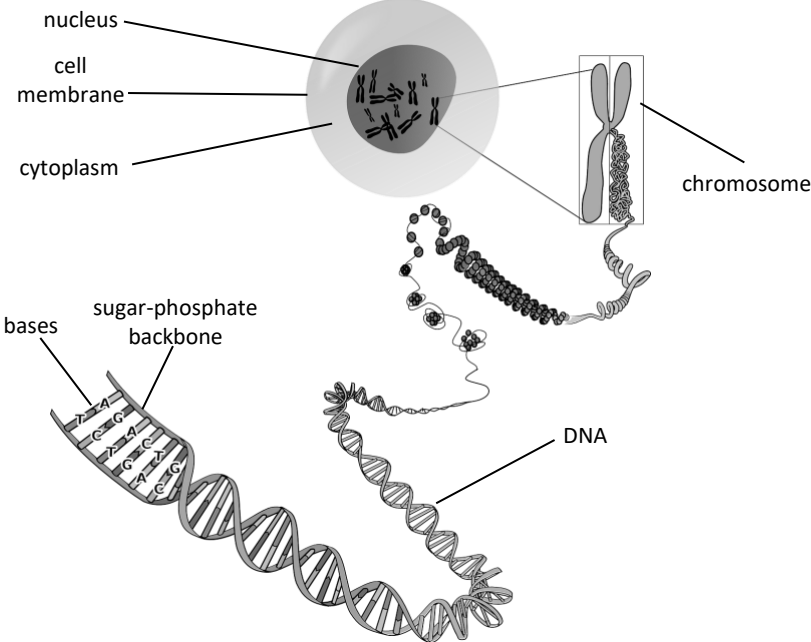
Chapter 2 [continued]

Section	Activity	Sample answers		
2.10	2	<i>Examples of organisms that reproduce using only sexual reproduction</i>	<i>Examples of organism that can reproduce using sexual or asexual reproduction</i>	<i>Examples of organisms that reproduce using only asexual reproduction</i>
		Pink salmon Sunflower Leopard frog Bald eagle Sea horse Sand scorpion Monarch butterfly Flat-back sea turtle Saguro cactus Red kangaroo Grizzly bear Earthworm	Honey bee Brittle star Garden strawberry Coast redwood	Baker's yeast Volvox (green algae) Salmonella Whiptail lizard Giant amoeba
[Note: There are many examples you could have used. The examples given here are from the interactive in Activity 1.]				

Chapter 3

Section	Activity	Sample answers
3.1	1	<ul style="list-style-type: none"> • genetic • double • sugar • bases • bond • specific • guanine • helix
	3	<div style="display: flex; align-items: center;"> <div style="flex: 1;"> <p style="text-align: center;">KEY: A – Adenine G – guanine T – Thymine C – cytosine ○ Phosphate ◡ Sugar (deoxyribose)</p> </div> <div style="flex: 1; border: 1px solid black; padding: 10px; margin-left: 20px;"> <p><i>Note:</i> You can have any order of base pairs, so long as you always pair A with T, and C with G.</p> </div> </div>
	4	<ul style="list-style-type: none"> a) DNA b) 2 c) Double-helix d) Thymine e) Cytosine f) Deoxyribose g) Sugar h) Thymine i) Adenine j) Sugar and phosphate

Chapter 3 [continued]

Section	Activity	Sample answers
3.1	5	<p>a) The first two scientists to publish a model of the structure of DNA were Watson and Crick.</p> <p>b) Franklin used X-ray crystallography to determine the double-helix shape of DNA. This was used without her permission by Watson and Crick to further their own work on the structure of DNA.</p>
	6	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>DNA nucleotide with adenine</p> </div> <div style="text-align: center;">  <p>DNA nucleotide with thymine</p> </div> <div style="text-align: center;">  <p>DNA nucleotide with cytosine</p> </div> <div style="text-align: center;">  <p>DNA nucleotide with guanine</p> </div> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>KEY:</p> <p> Phosphate  Sugar (deoxyribose)</p> </div>
3.2	1	 <p>nucleus</p> <p>cell membrane</p> <p>cytoplasm</p> <p>chromosome</p> <p>bases</p> <p>sugar-phosphate backbone</p> <p>DNA</p>
	2	<p>1:3, 2:1, 3:4, 4:6, 5:2, 6:5</p> <p><i>i.e. the definitions from top to bottom are:</i></p> <ul style="list-style-type: none"> • chromosome • double-helix • DNA • nucleotides • gene • nitrogenous base

Chapter 3 [continued]

Section	Activity	Sample answers																
3.2	3	<p>a) Binary code in computing allows many complex processes to occur, through the use of a language that contains only two numbers: 0 and 1. This helps to show how the four letters of DNA can be used similarly to code for complex information within living things.</p> <p>b) DNA replication prior to cell division ensures that each new cell formed receives the full genetic code, so that they can function correctly.</p> <p>c) Each chromosome is made of a long, coiled DNA molecule (along with proteins). Genes are short sections with specific bases along the DNA molecule of a chromosome.</p>																
3.3	1	<table border="1"> <thead> <tr> <th><i>Prokaryotic</i></th> <th><i>Eukaryotic</i></th> </tr> </thead> <tbody> <tr> <td>Bacteria, archaea</td> <td>Plants, animals, fungi</td> </tr> <tr> <td>Yes</td> <td>Yes</td> </tr> <tr> <td>Yes</td> <td>Yes</td> </tr> <tr> <td>Usually circular</td> <td>Non-looped</td> </tr> <tr> <td>Usually one</td> <td>Multiple</td> </tr> <tr> <td>In a nucleoid region</td> <td>In a membrane-bound nucleus</td> </tr> <tr> <td>In the plasmid</td> <td>Inside the mitochondria and chloroplasts.</td> </tr> </tbody> </table>	<i>Prokaryotic</i>	<i>Eukaryotic</i>	Bacteria, archaea	Plants, animals, fungi	Yes	Yes	Yes	Yes	Usually circular	Non-looped	Usually one	Multiple	In a nucleoid region	In a membrane-bound nucleus	In the plasmid	Inside the mitochondria and chloroplasts.
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Ext.		This theory suggests that both mitochondria and chloroplasts were once free-living prokaryotes that became a part of eukaryotic cells through endocytosis. As prokaryotic organisms, they would have had their own DNA. After engulfment, this DNA remained inside these structures.																
3.4	1	<p>a) Prior to cell division</p> <p>b) Various enzymes and other proteins</p> <p>c) Temporary</p> <p>d) The two original DNA strands that temporarily unwind.</p>																
	2	<p><i>Diagram 1:</i> DNA exists as a double-stranded molecule, made of bases joined to a sugar phosphate backbone.</p> <p><i>Diagram 2:</i> The two DNA strands unwind and separate. They each act as a template for the new nucleotides that are attracted to their complementary bases on the separated strands.</p> <p><i>Diagram 3:</i> The nucleotides have joined together, resulting in the formation of two identical double-stranded DNA molecules.</p>																

Chapter 3 [continued]

Section	Activity	Sample answers															
3.4	3	<p><i>Some of the information you may have dot-pointed from the video includes:</i></p> <ul style="list-style-type: none"> • DNA replication involves an assembly line of ‘biochemical machines’. • DNA replication is aided by helicase, which spins the DNA very quickly to unwind the double-stranded DNA into single strands. • One DNA strand is copied continuously. • The second DNA strand is copied backwards. This is more complicated. It involves drawing the strand out in loops to each be copied. 															
	4	<ul style="list-style-type: none"> • division • genetic • complex • replication • strands • fork • opposite • lagging • polymerase • added • proteins 															
3.6	1	<table border="1"> <thead> <tr> <th>Does cellular growth occur?</th> <th>Does DNA replication occur?</th> <th>Does cell division occur?</th> </tr> </thead> <tbody> <tr> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>✓</td> <td>✓</td> <td></td> </tr> <tr> <td>✓</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>✓</td> </tr> </tbody> </table>	Does cellular growth occur?	Does DNA replication occur?	Does cell division occur?	✓			✓	✓		✓					✓
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		✓															
2	<p>a) Growth phase b) To make identical daughter cells for growth and repair in the body. c) 2 d) S phase e) X shaped</p>																
3	<p>During the G₁ phase, chromosomes exist as a single chromatid, made of a single DNA molecule. During the S phase, DNA replication occurs. This results in each chromosome being made of two identical chromatids. Each chromatid is made of a single DNA molecule. The two DNA molecules are joined together at the centromere. During the M phase, cell division occurs by mitosis. The two chromatids separate into two identical daughter chromosomes.</p>																
4	<p>a) 1 b) 1 c) 2 d) 2 e) After DNA replication has occurred (i.e. after the S phase). f) Identical g) Centromere h) 1 or 2</p>																

Chapter 3 [continued]

Section	Activity	Sample answers
3.7	1	Prophase Metaphase 'M' for middle ... chromosomes meet in the middle Anaphase 'A' for away ... chromosomes move away Telophase 'T' for two ... two distinct cells begin to form
	2	• prophase • metaphase • anaphase • telophase
	3	<i>From top to bottom: 4, 3, 2, 1, 5</i>
	4	• one • two • repair • before • X • identical • DNA • organelle • opposite • spindle • movement
	6	a) Embryos are growing rapidly and so need mitosis in order to produce the cells needed for this growth. b) <i>Multiple correct answers, e.g.</i> • skin cells (for replacement, and for repair of cuts and abrasions) • cells lining the intestinal tract • cells lining the respiratory tract c) Yes. In asexual reproduction, offspring are created using mitosis. In all multicellular species, offspring need mitosis for growth and repair in order to survive, so that they can reproduce.
3.9	2	a) 46 b) 23 c) 23 d) None e) One from the mother (maternal copy) and one from the father (paternal copy). f) A pair of corresponding chromosomes. g) Eggs and sperm. h) All body cells, other than eggs and sperm. i) Cell division by meiosis.
	4	• division • sperm • one • replication • chromosomes • two • centre • sister • four • gametes • sexual
	5	<i>Check that your labels agree with the following information:</i> • Diploid (2n) cells occur throughout meiosis-I • Haploid (1n) cells only occur in the final step of meiosis-II • Homologous chromosomes are separated in meiosis-I • Sister chromatids are separated in meiosis-II

Chapter 3 [continued]

Section	Activity	Sample answers																														
3.10	1	1:3, 2:1, 3:4, 4:6, 5:2, 6:5 <i>i.e. the definitions from top to bottom are:</i> <ul style="list-style-type: none"> • gene • meiosis • homologous chromosomes • allele • crossing over • chromatid 																														
	2	Sexual reproduction involves fertilisation, which combines genetic material from two different individuals. Each gamete produced varies due to independent assortment in meiosis causing homologous chromosomes to separate randomly and crossing-over, which allows homologous chromosomes to exchange genetic material during meiosis.																														
3.11	1	<table border="1"> <thead> <tr> <th></th> <th><i>Mitosis</i></th> <th><i>Meiosis</i></th> </tr> </thead> <tbody> <tr> <td><i>Purpose</i></td> <td>Growth and repair</td> <td>Gamete formation</td> </tr> <tr> <td><i>Number of parent cells</i></td> <td>1</td> <td>1</td> </tr> <tr> <td><i>Number of daughter cells</i></td> <td>2</td> <td>4</td> </tr> <tr> <td><i>Are the daughter cells identical to parent cells?</i></td> <td>Yes</td> <td>No</td> </tr> <tr> <td><i>Are the daughter cells identical to each other?</i></td> <td>Yes</td> <td>No</td> </tr> <tr> <td><i>Are the daughter cells haploid or diploid?</i></td> <td>Diploid</td> <td>Haploid</td> </tr> <tr> <td><i>Does cytokinesis occur once or twice?</i></td> <td>Once</td> <td>Twice</td> </tr> <tr> <td><i>Can crossing over occur?</i></td> <td>No</td> <td>Yes</td> </tr> <tr> <td><i>Contribution to continuity of the species</i></td> <td>Allows growth and repair in multicellular organisms, thus allowing them to survive to reproduce. Also involved in some forms of asexual reproduction, e.g. budding in yeast, amoeba.</td> <td>Allows sexual reproduction and increases genetic variety in the offspring.</td> </tr> </tbody> </table>		<i>Mitosis</i>	<i>Meiosis</i>	<i>Purpose</i>	Growth and repair	Gamete formation	<i>Number of parent cells</i>	1	1	<i>Number of daughter cells</i>	2	4	<i>Are the daughter cells identical to parent cells?</i>	Yes	No	<i>Are the daughter cells identical to each other?</i>	Yes	No	<i>Are the daughter cells haploid or diploid?</i>	Diploid	Haploid	<i>Does cytokinesis occur once or twice?</i>	Once	Twice	<i>Can crossing over occur?</i>	No	Yes	<i>Contribution to continuity of the species</i>	Allows growth and repair in multicellular organisms, thus allowing them to survive to reproduce. Also involved in some forms of asexual reproduction, e.g. budding in yeast, amoeba.	Allows sexual reproduction and increases genetic variety in the offspring.
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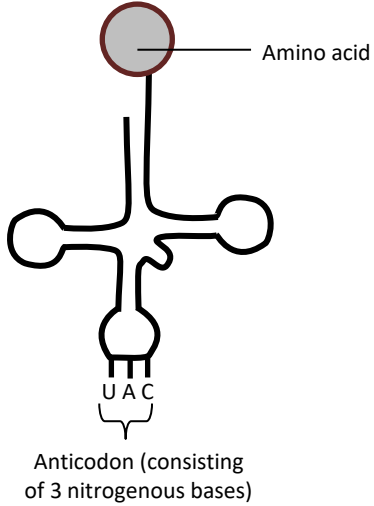
Chapter 4

Section	Activity	Sample answers																					
4.1	2	<table border="1"> <thead> <tr> <th>Type of protein</th> <th>Brief description of this type of protein's role in humans</th> <th>Example of this type of protein</th> </tr> </thead> <tbody> <tr> <td>Enzymes</td> <td>To catalyse (speed up) biological reactions.</td> <td>Lactase</td> </tr> <tr> <td>Signalling</td> <td>Used to signal within the body so that cells can communicate with each other.</td> <td>Insulin</td> </tr> <tr> <td>Transport</td> <td>Used to help move substances in the body.</td> <td>Haemoglobin</td> </tr> <tr> <td>Storage</td> <td>Used to help store substances for later use.</td> <td>Ferritin</td> </tr> <tr> <td>Motor</td> <td>Assist with muscle movement.</td> <td>Actin</td> </tr> <tr> <td>Defensive</td> <td>Assist in fighting disease-causing organisms.</td> <td>Antibodies</td> </tr> </tbody> </table> <p>[Note: There are several other types of proteins that you could have used, as well as many other examples of each type of protein.]</p>	Type of protein	Brief description of this type of protein's role in humans	Example of this type of protein	Enzymes	To catalyse (speed up) biological reactions.	Lactase	Signalling	Used to signal within the body so that cells can communicate with each other.	Insulin	Transport	Used to help move substances in the body.	Haemoglobin	Storage	Used to help store substances for later use.	Ferritin	Motor	Assist with muscle movement.	Actin	Defensive	Assist in fighting disease-causing organisms.	Antibodies
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	3	<p>a) DNA contains genes, which provide the instructions for making proteins. Ribosomes use instructions from the DNA in genes to make proteins out of amino acids. So, both are essential for making proteins.</p> <p>b) Proteins are 3D structures made of chains of amino acids called polypeptides. Each protein contains one or more polypeptides that form a 3D shape due to bonding between the different amino acids in the polypeptide(s).</p> <p>c) <i>Multiple correct answers are possible, referring to different proteins, e.g.</i> Proteins are essential for many aspects of correct functioning in an organism. Enzymes are a type of protein that catalyse (speed up) biological reactions and are essential to ensure metabolic reactions occur quickly enough to sustain life. Defensive proteins, such as antibodies, are essential to fight disease-causing organisms to maintain an organism's health.</p>																					

Chapter 4 [continued]

Section	Activity	Sample answers										
4.2	3	a) Nucleus b) Genes c) Transcription d) Amino acids e) Ribosomes f) Translation g) The polypeptides are folded into a 3D shape.										
	4	From top to bottom: 3, 6, 2, 5, 1, 4										
	5	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>DNA</th> <th>RNA</th> </tr> </thead> <tbody> <tr> <td>Deoxyribonucleic acid</td> <td>Ribonucleic acid</td> </tr> <tr> <td>2</td> <td>1</td> </tr> <tr> <td>Deoxyribose</td> <td>Ribose</td> </tr> <tr> <td>A T C G</td> <td>A U G C</td> </tr> </tbody> </table>	DNA	RNA	Deoxyribonucleic acid	Ribonucleic acid	2	1	Deoxyribose	Ribose	A T C G	A U G C
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2	1											
Deoxyribose	Ribose											
A T C G	A U G C											
6	• one • sugar • thymine • uracil											
4.3	1	a) G G C G A C A C G U U A G U b) A U G G U A A U C C G C G A c) U G U C A A U C C C G G A G d) C U A G U A C U C A U A U G										
	2	G A C U G C C U A G U C G G C G U U										
	3	mRNA is important as it transcribes the genetic instructions in DNA for making a polypeptide. Being mobile, mRNA then takes these instructions to the ribosomes where they are translated into forming a protein.										
4.4	2	<pre> graph LR A[mRNA binds to a ribosome in the cytoplasm] --> B[Each codon within the mRNA is translated (processed) by the ribosome] B --> C[The ribosome matches the mRNA codons to complementary anticodons on tRNA] C --> D[The amino acid on each matching tRNA is added to a chain to form a polypeptide] </pre>										

Chapter 4 [continued]

Section	Activity	Sample answers
4.4	3	<p>a) See diagram on right:</p>  <p>b) A U C G</p> <p>c) Transfer</p> <p>d) A lowercase 't'.</p> <p>e) tRNA carries triplets of bases called anticodons, as well as a corresponding amino acid. The tRNA anticodons bind to the complementary base pairs in the mRNA codon to ensure the correct amino acid is added to the polypeptide being formed.</p> <p>f) The anticodon in tRNA is essential for bringing the correct amino acid to the complementary codon in the mRNA. This ensures that correct amino acid sequences are in the polypeptide chain for the protein being formed.</p>
	4	<p>a) A U G</p> <p>b) G A U</p> <p>c) A U U</p> <p>d) C C U</p>
	5	<p>a) met (full name: methionine)</p> <p>b) UAA, UAG, UGA</p> <p>c) (i) met–pro–lys–tyr–arg–gly–gly–ile–thr–stop (ii) met–glu–asp–asn–pro–ile–val–arg–phe–stop</p>
4.5	3	<p><i>Some examples of suitable labels and descriptions that you could have added to the diagram include:</i></p> <ul style="list-style-type: none"> • DNA – contains genetic information and one strand acts as a template • Gene – a section of the DNA is being transcribed into mRNA • mRNA – a mobile copy (transcript) of the DNA segment (gene) • Ribosome – this facilitates the translation of mRNA into a polypeptide • tRNA – brings amino acids to the ribosome • mRNA – this is translated at the ribosome • Polypeptide chain – starting to form • Nucleus – where DNA is stored and transcription occurs • Cytoplasm – where translation occurs

Chapter 4 [continued]

Section	Activity	Sample answers
	4	<ul style="list-style-type: none"> a) polypeptide b) RNA c) tRNA d) protein e) DNA
4.5	5	<p><i>[Note: Several descriptions below are longer than required for a brief description, to include some of the many things you could have written.]</i></p> <ul style="list-style-type: none"> a) DNA: Double-stranded nucleic acid, its nucleotides each contain a nitrogenous base, deoxyribose sugar and phosphate. It contains an organism's genetic code. b) mRNA: Single-stranded nucleic acid, its nucleotides each contain a nitrogenous base, ribose sugar and phosphate. It transcribes (copies) the code on DNA in the nucleus and carries it to a ribosome in the cytoplasm for translation. c) Transcription: The process of mRNA transcribing (copying) a DNA base sequence for making a protein. d) Ribosome: An organelle in the cytoplasm that carries out translation of the mRNA code to make a protein. e) tRNA: Single-stranded nucleic acid, with three nitrogenous bases (anticodon) on one end and an amino acid on the other end. Each tRNA binds to a specific amino acid and brings it to the ribosome during translation. f) Codon: A triplet of bases in mRNA that are matched to an anticodon on tRNA during protein synthesis at a ribosome. g) Anticodon: The triplet of bases at the end of tRNA that are matched to an mRNA codon by the ribosomes. h) Stop codon: A codon in mRNA that indicates the end of translation of a sequence into a polypeptide. i) Start codon: A codon in mRNA that indicates the starting point for the translation of an mRNA sequence and always codes for 'met', an amino acid. j) Translation: The process of ribosomes assembling amino acids to form a polypeptide from the instructions in mRNA k) Amino acid: The building block for making a polypeptide. l) Polypeptide: Formed by a chain of amino acids. One or more polypeptides form a protein. m) Protein: A 3D structure formed by one or more polypeptides. Essential nutrient for the human body.

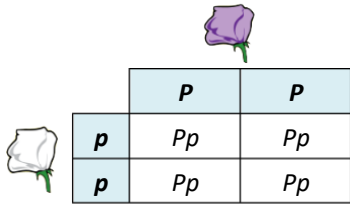
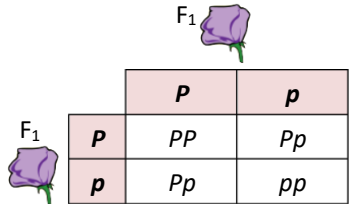
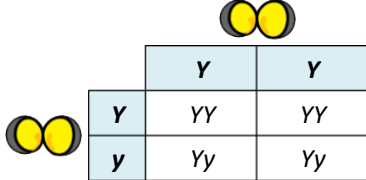
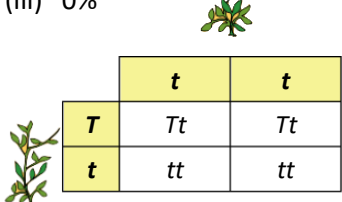
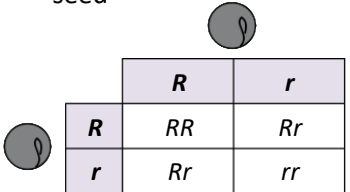
Chapter 4 [continued]

Section	Activity	Sample answers
4.5	6	<p>a) Encoding DNA into mRNA involves copying (transcribing) the base order in the 'language' of nitrogenous bases. In contrast, polypeptides are made by converting (translating) the nitrogenous bases language in mRNA into a different 'language' – that of amino acids.</p> <p>b) Polypeptide synthesis is essential for cells as proteins consist of one or more polypeptides folded into a 3D shape. Proteins are vital for cells to function correctly, e.g. enzymes are proteins that act as biological catalysts, antibodies are proteins that are part of the immune system.</p>
4.6	1	<p>a) A genotype is the genetic makeup of an organism, while a phenotype is the observed physical expression of the genes in an organism. [Note: The genotype and phenotype may differ due to environmental influences.]</p> <p>b) The amount and type of melanin produced in the skin is controlled by several genes. If more melanin is produced, the skin will be darker and vice versa.</p> <p>c) The greater the exposure to UV from sunlight, the more melanin is produced. This will cause the skin to become darker.</p>
	4	<p>a) Level of anxiety.</p> <p>b) The amount of nurturing during childhood (frequency of maternal licking).</p> <p>c) All young rats have methyl groups attached to the GR gene. This reduces gene expression. However, in rats that receive high levels of maternal nurturing (maternal licking), signalling pathways remove methyl groups from the GR gene, increasing GR gene expression.</p>
	5	<ul style="list-style-type: none"> • chemicals • expressed • diet • more • phenotype • inherited • transcribed • off • methyl • histone • switched • synthesis • acetyl • loosely

Chapter 5

Section	Activity	Sample answers
5.1	1	a) A field of Biology that looks at genes and the way they are inherited. b) 2 c) Diploid d) Alleles e) Freckles or no freckles f) Yes g) Yes h) No i) <i>F</i> – freckles j) <i>f</i> – no freckles k) <i>FF</i> and <i>ff</i>
	2	a) Heterozygous b) Homozygous c) Heterozygous d) Homozygous e) Homozygous f) Heterozygous g) Heterozygous h) Homozygous
	3	a) Dominant b) Recessive c) Dominant d) Dominant e) Dominant f) Dominant g) Dominant h) Recessive
	5	a) (i) Heterozygous (ii) <i>T</i> or <i>t</i> (iii) 50% (iv) 50% b) (i) <i>t</i> (ii) 100%
	6	a) 25% b) 50% c) 25% d) 75% e) 25% f) 1:2:1 g) 3:1

Chapter 5 [continued]

Section	Activity	Sample answers
5.2	1	a) Homozygous b) Heterozygous
	2	a) Purple flower colour b) Wrinkled seeds c) Green seed colour d) Yellow seed colour e) Tall stem length f) Short stem length
	3	a) tt b) pp c) TT or Tt d) RR or Rr e) YY or Yy f) PP or Pp
	4	<p>a)</p>  <p>b) Pp c) Purple flower colour</p> <p>d)</p>  <p>e) 75% f) 25% g) 1:2:1</p>
	5	<p>a)</p> <p>(i) 100% (ii) 0% (iii) 2 YY: 2 Yy</p>  <p>b)</p> <p>(i) 2 tall : 2 short (ii) 50% (iii) 0%</p>  <p>c)</p> <p>(i) 1 RR : 2 Rr : 1 rr (ii) 3 round seeds : 1 wrinkled seed</p>  <p>d) The expected ratio will not always be precisely represented when using such a small sample size.</p>

Chapter 5 [continued]

Section	Activity	Sample answers																											
5.3	1	<p>a) Red flower colour</p> <p>b) White flower colour</p> <p>c) Pink flower colour</p> <p>d) Two alleles (C^R and C^W)</p> <p>e) Three phenotypes (red, white & pink)</p> <p>f)</p> <table border="1" style="margin-left: 40px;"> <tr> <td></td> <td>C^W</td> <td>C^R</td> </tr> <tr> <td>C^R</td> <td>$C^R C^W$</td> <td>$C^R C^R$</td> </tr> <tr> <td>C^W</td> <td>$C^W C^W$</td> <td>$C^W C^R$</td> </tr> </table>		C^W	C^R	C^R	$C^R C^W$	$C^R C^R$	C^W	$C^W C^W$	$C^W C^R$																		
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2	<p>a)</p> <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Genotype</th> <th>Phenotype</th> </tr> </thead> <tbody> <tr> <td>BB</td> <td>Brown</td> </tr> <tr> <td>BW</td> <td>Roan</td> </tr> <tr> <td>WW</td> <td>White</td> </tr> </tbody> </table> <p>b)</p> <table border="1" style="margin-left: 40px;"> <tr> <td></td> <td>W</td> <td>W</td> </tr> <tr> <td>B</td> <td>BW</td> <td>BW</td> </tr> <tr> <td>W</td> <td>WW</td> <td>WW</td> </tr> </table> <p>(i) 2 roan : 2 white (ii) 2 BW : 2 WW (iii) 50%</p> <p>c)</p> <table border="1" style="margin-left: 40px;"> <tr> <td></td> <td>B</td> <td>W</td> </tr> <tr> <td>B</td> <td>BB</td> <td>BW</td> </tr> <tr> <td>W</td> <td>BW</td> <td>WW</td> </tr> </table> <p>(i) 1 brown : 2 roan : 1 white</p>	Genotype	Phenotype	BB	Brown	BW	Roan	WW	White		W	W	B	BW	BW	W	WW	WW		B	W	B	BB	BW	W	BW	WW	<p>g) 2 pink : 1 red : 1 white</p> <p>h) 2 $C^R C^W$: 1 $C^R C^R$: 1 $C^W C^W$</p> <p>i) The heterozygous phenotype of pink flowers from the cross between homozygous red and homozygous white snapdragons is a blend of the homozygous phenotypes.</p>	
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BB	Brown																												
BW	Roan																												
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Chapter 5 [continued]

Section	Activity	Sample answers																																												
5.4	1	<p>a) (i) Black/brown (v) White with black tips (Himalayan) (ii) Black/brown (vi) Greyish (Chinchilla) (iii) Black/brown (vii) Light greyish with black tips (iv) White (viii) White with black tips (Himalayan)</p> <p>b) All $c^{ch}c$ c) 2 Black/brown: 1 Himalayan: 1 white</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td></td><td>c</td><td>c</td></tr> <tr><td>c^{ch}</td><td>$c^{ch}c$</td><td>$c^{ch}c$</td></tr> <tr><td>c^{ch}</td><td>$c^{ch}c$</td><td>$c^{ch}c$</td></tr> </table> <table border="1" style="display: inline-table;"> <tr><td></td><td>C⁺</td><td>c</td></tr> <tr><td>c^h</td><td>C^+c^h</td><td>c^hc</td></tr> <tr><td>c</td><td>C^+c</td><td>cc</td></tr> </table> <p>d) A rabbit is more likely to be cold at its extremities, e.g. the tips of its ears and feet. These colder regions enable the enzyme produced by the c^h allele to function, thus aiding the production of dark pigment in the hair. Hence the black fur occurring at these locations in Himalayan rabbits.</p>		c	c	c^{ch}	$c^{ch}c$	$c^{ch}c$	c^{ch}	$c^{ch}c$	$c^{ch}c$		C⁺	c	c^h	C^+c^h	c^hc	c	C^+c	cc																										
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	C⁺	c																																												
c^h	C^+c^h	c^hc																																												
c	C^+c	cc																																												
2	<p>a) (i) Type A (ii) Type B (iii) Type AB (iv) Type A (v) Type B (vi) Type O</p> <p>b) (i) 25% (ii) 50%</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td></td><td>I^A</td><td>I^B</td></tr> <tr><td>I^A</td><td>$I^A I^A$</td><td>$I^A I^B$</td></tr> <tr><td>I^B</td><td>$I^A I^B$</td><td>$I^B I^B$</td></tr> </table> <p>c) (i) Yes (ii) $I^B i$</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td></td><td>I^A</td><td>I^B</td></tr> <tr><td>I^B</td><td>$I^A I^B$</td><td>$I^B I^B$</td></tr> <tr><td>i</td><td>$I^A i$</td><td>$I^B i$</td></tr> </table> <table border="1" style="display: inline-table;"> <tr><td></td><td>I^A</td><td>I^B</td></tr> <tr><td>I^B</td><td>$I^A I^B$</td><td>$I^B I^B$</td></tr> <tr><td>I^B</td><td>$I^A I^B$</td><td>$I^B I^B$</td></tr> </table> <p>d) Type O</p> <p>e) Alfie is the father – as Alfie and Kate can produce a child with blood type AB, while Jerry and Kate cannot.</p> <p>... with Jerry:</p> <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><td></td><td>I^A</td><td>I^A or i</td></tr> <tr><td>i</td><td>$I^A i$</td><td>$I^A i$ or ii</td></tr> <tr><td>i</td><td>$I^A i$</td><td>$I^A i$ or ii</td></tr> </table> <p>... with Alfie:</p> <table border="1" style="display: inline-table;"> <tr><td></td><td>I^A</td><td>I^A or i</td></tr> <tr><td>I^B</td><td>$I^A I^B$</td><td>$I^A I^B$ or $I^B i$</td></tr> <tr><td>I^B or i</td><td>$I^A I^B$ or $I^A i$</td><td>$I^A I^B$ or $I^A i$ or $I^B i$ or ii</td></tr> </table>		I^A	I^B	I^A	$I^A I^A$	$I^A I^B$	I^B	$I^A I^B$	$I^B I^B$		I^A	I^B	I^B	$I^A I^B$	$I^B I^B$	i	$I^A i$	$I^B i$		I^A	I^B	I^B	$I^A I^B$	$I^B I^B$	I^B	$I^A I^B$	$I^B I^B$		I^A	I^A or i	i	$I^A i$	$I^A i$ or ii	i	$I^A i$	$I^A i$ or ii		I^A	I^A or i	I^B	$I^A I^B$	$I^A I^B$ or $I^B i$	I^B or i	$I^A I^B$ or $I^A i$	$I^A I^B$ or $I^A i$ or $I^B i$ or ii
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Chapter 5 [continued]

Section	Activity	Sample answers									
5.4	2	<p>f) Kyle</p> <table border="1" style="margin-left: 40px;"> <tr> <td></td> <td style="background-color: #f4b084;"><i>i</i></td> <td style="background-color: #f4b084;"><i>i</i></td> </tr> <tr> <td style="background-color: #f4b084;"><i>I^A</i></td> <td><i>I^Ai</i></td> <td><i>I^Ai</i></td> </tr> <tr> <td style="background-color: #f4b084;"><i>I^B</i></td> <td><i>I^Bi</i></td> <td><i>I^Bi</i></td> </tr> </table>		<i>i</i>	<i>i</i>	<i>I^A</i>	<i>I^Ai</i>	<i>I^Ai</i>	<i>I^B</i>	<i>I^Bi</i>	<i>I^Bi</i>
		<i>i</i>	<i>i</i>								
<i>I^A</i>	<i>I^Ai</i>	<i>I^Ai</i>									
<i>I^B</i>	<i>I^Bi</i>	<i>I^Bi</i>									
	3	<p>g) (i) Laura (ii) No – blood typing can rule out a suspect, but it cannot prove whether a suspect committed a crime or not, as many other people could have Type A blood.</p>									
5.5	1	<p>a) Male b) 2 c) 22 d) X e) X or Y f) 50% g) Father</p>									
	3	<p>a) X^BY b) X^BX^B or X^BX^b c) X^bY d) X^BX^b e) X^bX^b</p>									
	4	<p>a) Male, red-green colour blind b) Female, normal vision (but she will be a carrier of red-green colour blindness) c) Female, normal vision d) Male, normal vision</p>									
	5	<p>a) (i) No (ii) No (iii) Impossible (0%) (iv) Very likely (100% probability) b) (i) 25% (ii) Their sons (iii) $1 X^BX^B : 1 X^BX^b : 1 X^BY : 1 X^bY$</p> <table border="1" style="margin-left: 40px;"> <tr> <td></td> <td style="background-color: #d9ead3;">X^B</td> <td style="background-color: #d9ead3;">Y</td> </tr> <tr> <td style="background-color: #d9ead3;">X^B</td> <td>X^BX^B</td> <td>X^BY</td> </tr> <tr> <td style="background-color: #d9ead3;">X^b</td> <td>X^BX^b</td> <td>X^bY</td> </tr> </table>		X^B	Y	X^B	X^BX^B	X^BY	X^b	X^BX^b	X^bY
	X^B	Y									
X^B	X^BX^B	X^BY									
X^b	X^BX^b	X^bY									

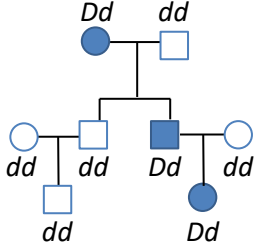





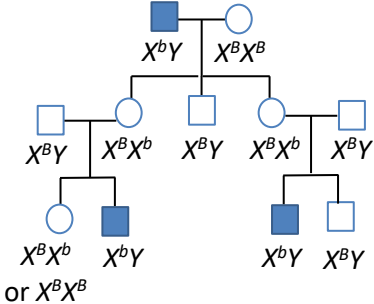
Chapter 5 [continued]

Section	Activity	Sample answers									
5.5	5	<p>c) (i) X^bY (ii) David (his father) (iii) Holly (his mother) (iv) X^BX^b</p> <p>(v) X^BX^B or X^BX^b</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="background-color: #ffffcc;">X^B</td> <td style="background-color: #ffffcc;">Y</td> </tr> <tr> <td style="background-color: #ffffcc;">X^B</td> <td>X^BX^B</td> <td>X^BY</td> </tr> <tr> <td style="background-color: #ffffcc;">X^b</td> <td>X^BX^b</td> <td>X^bY</td> </tr> </table> <p>(vi) No</p>		X^B	Y	X^B	X^BX^B	X^BY	X^b	X^BX^b	X^bY
		X^B	Y								
	X^B	X^BX^B	X^BY								
	X^b	X^BX^b	X^bY								
6	<p>a) (i) Male, muscular dystrophy (ii) Male, no muscular dystrophy (iii) Female, no muscular dystrophy (iv) Female, no muscular dystrophy (but she is a carrier) (v) Female, muscular dystrophy</p> <p>b) Females inherit two copies of the X chromosome. This gives them two chances to inherit the dominant allele that results in no muscular dystrophy. Also, females can only get muscular dystrophy from a father with the condition. People with this condition are unlikely to deliberately have children given the severity of the illness and its impact on lifespan.</p> <p>c) (i) Female (ii) 50%</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="background-color: #d9e1f2;">X^D</td> <td style="background-color: #d9e1f2;">X^d</td> </tr> <tr> <td style="background-color: #d9e1f2;">X^D</td> <td>X^DX^D</td> <td>X^DX^d</td> </tr> <tr> <td style="background-color: #d9e1f2;">Y</td> <td>X^DY</td> <td>X^dY</td> </tr> </table>		X^D	X^d	X^D	X^DX^D	X^DX^d	Y	X^DY	X^dY	
	X^D	X^d									
X^D	X^DX^D	X^DX^d									
Y	X^DY	X^dY									
7	<p>a) Sex chromosome – as the disease is occurring more often in males than females, as would occur if it was a sex-inherited trait.</p> <p>b) X chromosome – as it does occur occasionally in females, who do not have a Y chromosome.</p> <p>c) 2 females without haemophilia : 2 males without haemophilia (both are carriers)</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="background-color: #d9ead3;">X^h</td> <td style="background-color: #d9ead3;">Y</td> </tr> <tr> <td style="background-color: #d9ead3;">X^H</td> <td>X^HX^h</td> <td>X^HY</td> </tr> <tr> <td style="background-color: #d9ead3;">X^H</td> <td>X^HX^h</td> <td>X^HY</td> </tr> </table>		X^h	Y	X^H	X^HX^h	X^HY	X^H	X^HX^h	X^HY	
	X^h	Y									
X^H	X^HX^h	X^HY									
X^H	X^HX^h	X^HY									
8	<p>a) Red eyes b) X^BX^b c) X^bY d) (i) 50% (ii) 50% (iii) X^BY or X^bY</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="background-color: #d9ead3;">X^B</td> <td style="background-color: #d9ead3;">X^b</td> </tr> <tr> <td style="background-color: #d9ead3;">X^b</td> <td>X^BX^b</td> <td>X^bX^b</td> </tr> <tr> <td style="background-color: #d9ead3;">Y</td> <td>X^BY</td> <td>X^bY</td> </tr> </table>		X^B	X^b	X^b	X^BX^b	X^bX^b	Y	X^BY	X^bY	
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X^b	X^BX^b	X^bX^b									
Y	X^BY	X^bY									

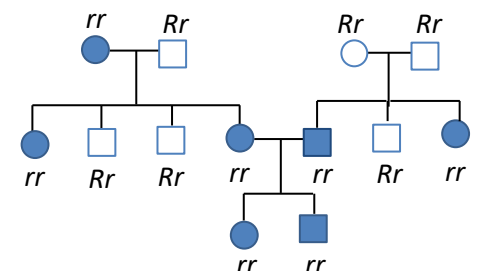
Chapter 5 [continued]

Section	Activity	Sample answers									
5.5	9	<p>a) Sex-linked inheritance and codominance.</p> <p>b) (i) Male, black fur (iv) Female, tortoiseshell fur (ii) Male, orange fur (v) Female, orange fur (iii) Female, black fur</p> <p>c) Female. The tortoiseshell phenotype only occurs in heterozygotes (genotype $X^B X^O$) and this is only possible in female cats.</p> <p>d) 1 black female: 1 tortoiseshell female : 1 black male : 1 orange male</p> <p><i>[Note: This could also be written as: 2 black : 1 tortoiseshell : 1 orange]</i></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>X^B</td> <td>X^O</td> </tr> <tr> <td>X^B</td> <td>$X^B X^B$</td> <td>$X^B X^O$</td> </tr> <tr> <td>Y</td> <td>$X^B Y$</td> <td>$X^O Y$</td> </tr> </table>		X^B	X^O	X^B	$X^B X^B$	$X^B X^O$	Y	$X^B Y$	$X^O Y$
	X^B	X^O									
X^B	$X^B X^B$	$X^B X^O$									
Y	$X^B Y$	$X^O Y$									
5.6	1	<p><i>You may have included some of the following ideas:</i></p> <ul style="list-style-type: none"> • It would be slow – humans have a relatively long gestation (9 months). • It would be slow – humans typically only have one baby at a time. • Cross-breeding requires large numbers of offspring – yet many people only want to have a small number of children. • Most people would not wish to participate in such experiments. • Experimenting with humans requires ethics approval and breeding experiments are unlikely to meet ethics requirements. • Cross-breeding often involves crossing with multiple individuals – most people would not wish to do this. 									
	2	<p>a) 9</p> <p>b) 4</p> <p>c) 4</p> <p>d) 2</p> <p>e) III-2</p> <p>f) Grandfather/grandson</p> <p>g) Grandfather/granddaughter</p> <p>h) Cousins</p> <p>i) <i>[Note: Any letter can be used to represent dominant and recessive alleles for these questions, e.g. B/b or T/t, etc. These answers use B/b.]</i></p> <p>(i) <i>bb</i> (iv) <i>Bb</i></p> <p>(ii) <i>bb</i> (v) <i>Bb</i></p> <p>(iii) <i>Bb</i> (vi) <i>bb</i></p>									

Chapter 5 [continued]

Section	Activity	Sample answers
	3	<p>a) (i) Recessive (ii) Heterozygous (iii) Homozygous</p> <p>b) (i) Dominant (ii) Heterozygous (iii) Either [Note: He could be homozygous dominant or heterozygous.]</p> <p>c) (i) Autosomal recessive (iv) Autosomal dominant (ii) Sex linked (recessive) (v) Autosomal dominant (iii) Autosomal dominant (vi) Sex linked (recessive)</p>
5.6	4	<p>a) On this family tree: I-1, II-3 and III-2 are Dd (shaded). All others are dd (unshaded).</p>  <p>b) </p> <p>KEY:  = free earlobes  = attached earlobes</p> <p>KEY:  = free earlobes  = attached earlobes</p> <p>c) (i) Sex-linked (recessive) (ii)</p> 

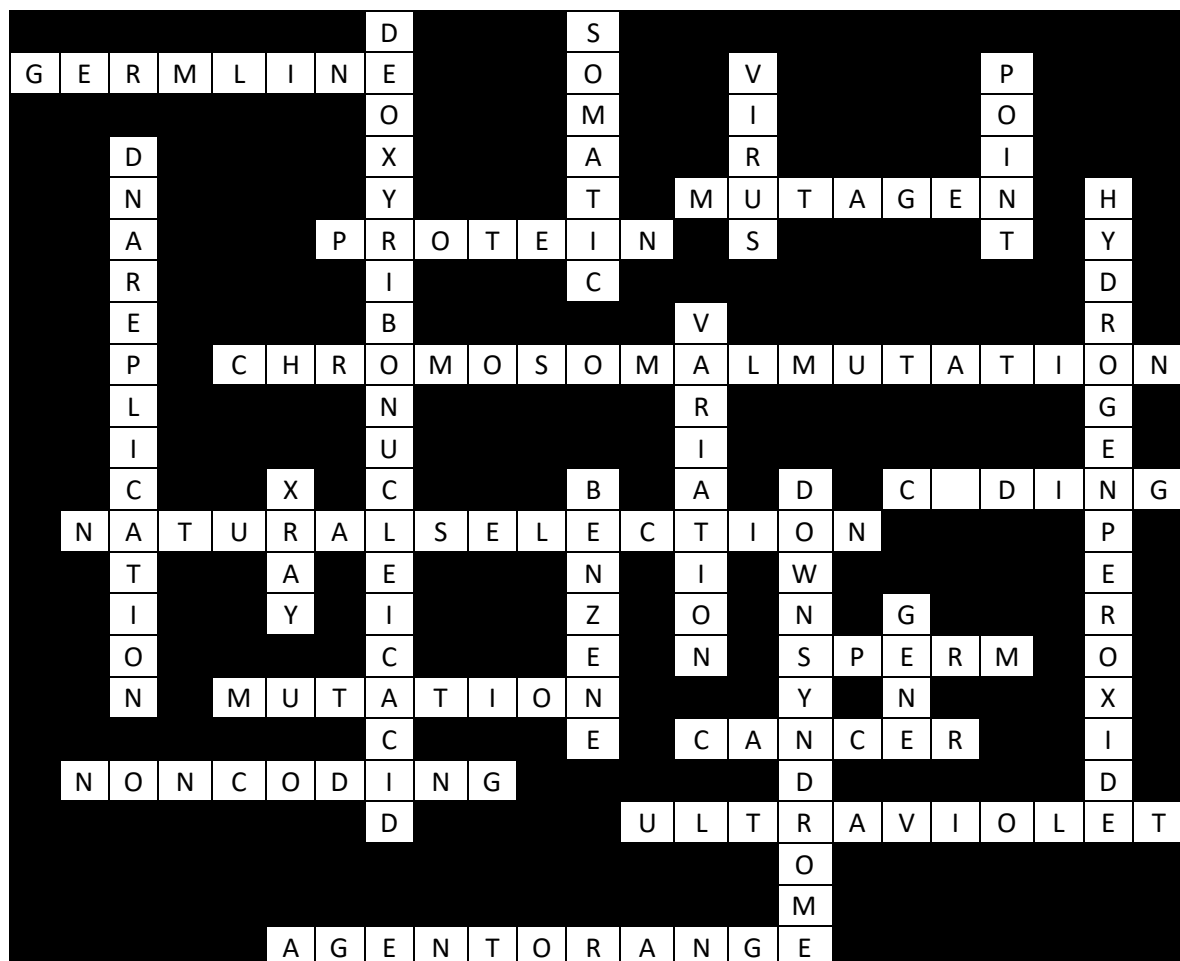
Chapter 5 [continued]

Section	Activity	Sample answers
5.6	4	<p>d) (i) Autosomal recessive</p> <p>(ii)</p> 
5.7	2	<ol style="list-style-type: none"> 1. a 2. b 3. d 4. b 5. c 6. a [Note: The genotype AABBCc has 6 dark skin alleles.] 7. c [Note: The genotype aabbcc has 0 dark skin alleles.] 8. c 9. c 10. d
5.8	1	<ol style="list-style-type: none"> a) This introduces an additional variable (as the ages differ in each year group). This is likely to impact on the validity of the results – as height is known to increase with age during childhood and adolescent years. b) This allows more data to be collected in a shorter period of time, as each member of the group can assist in taking measurements. It also allows data to be recorded by one group member, while another is measuring. c) <i>Your answer will be specific to your chosen sample group.</i> d) <i>Your answer should be specific to your chosen approach. The following is an example of an answer that could be given:</i> The group will work in pairs to measure and record heights. A tape measure will be used to measure the height of individuals from floor to top of head. Each pair in the group will be allocated 10 named individuals to measure. The data from each pair will then be combined.

Module 6: Genetic Change

Chapter 6

Section	Activity	Sample answers
6.1	3	1:2, 2:3, 3:4, 4:1, 5:8, 6:7, 7:5, 8:6 <i>i.e. the definitions from top to bottom are:</i> • mutagen • DNA • Base • Mutation • Somatic mutation • Germ-line mutation • Chromosome mutation • Base mutation
	4	• changes • corrected • replication • mutagens • chemicals • UV • coding • protein • compensate • cancers • gametes • inherited • alleles • population • helpful
	5	See crossword below



Chapter 6 [continued]

Section	Activity	Sample answers
6.1	6	<p>a) X-rays are a form of radiation that can cause mutations. Covering her abdomen with lead prevents germ-line mutations occurring that could harm the gametes (eggs) in her ovaries.</p> <p>b) Radiation from the atomic bombs would have caused somatic mutations in survivors, leading to cancers, as well as germ-line mutations in their gametes, causing unusual genetic conditions in their offspring.</p> <p>c) Most somatic mutations can be compensated for by surrounding healthy cells. Sometimes cells with a somatic mutation die and are replaced through mitotic cell division of nearby healthy cells.</p> <p>d) These mutations can lead to new alleles in gametes. If inherited by offspring, variation occurs. Better suited offspring survive and reproduce, and so a gradual change can occur in the gene pool of the population.</p> <p>e) It is unlikely that one mutagen would cause multiple favourable somatic mutations in sufficient body cells for a person's phenotype to change, as in Spider-Man. It is possible that a mutagen could cause one or more mutations. However, these would probably be a mixture of harmful and beneficial mutations.</p> <p>[Note: New alleles are more likely to be formed and introduced by germ-line mutations and so would affect the offspring, not an adult. This is because one mutation to a gamete can result in offspring with the same mutation in all their cells.]</p>
6.2	1	<p>a) High</p> <p>b) Short</p> <p>c) Ionising</p> <p>d) DNA relies on bonds between the bases to hold the two strands together. DNA also has bonds between the sugars, phosphates and bases. Radiation can damage the DNA structure by breaking these bonds apart.</p>
	3	<p>a) Viruses do not have any ribosomes for making proteins.</p> <p>b) The viral DNA is incorporated into the DNA of the bacterium.</p> <p>c) Becoming a part of a bacterium's DNA results in the bacterial DNA being altered and something that alters DNA is termed a mutagen.</p>
	4	<p>a) They cause a kink in DNA by forming a bond between two adjacent bases.</p> <p>b) Two thymine bases</p> <p>c) Two cytosine bases</p> <p>d) A mutagen is something that can cause mutations. Mutations are any changes to the DNA of an organism. UV causes mutations by changing DNA bonding to have pyrimidine dimers, and so it is a mutagen.</p>

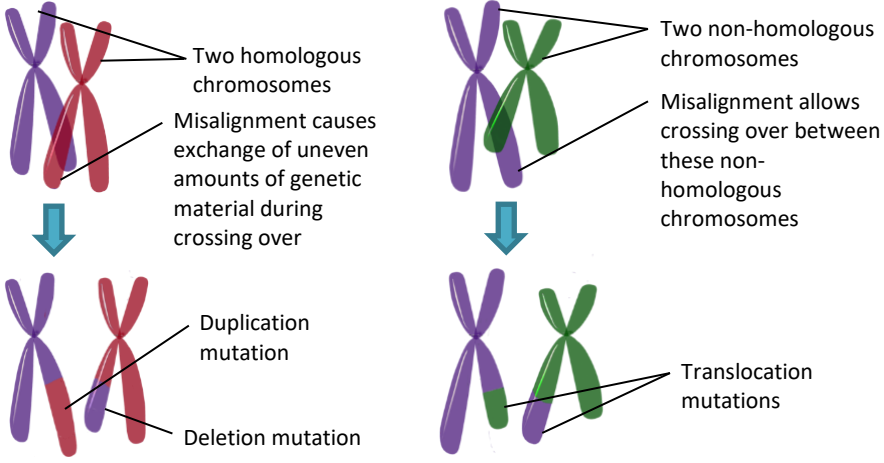
Chapter 6 [continued]

Section	Activity	Sample answers		
6.3	1	<p>a) DNA \Rightarrow mRNA \Rightarrow polypeptide \Rightarrow protein transcription translation processing</p> <p>b) They contain uracil instead of thymine</p> <p>c) A triplet of bases in the mRNA that corresponds to an amino acid.</p> <p>d) A start codon allows a ribosome to determine the starting point for translating the code in a strand of mRNA.</p> <p>e) It discontinues (stops) the translation of the mRNA.</p>		
	2	<p>a) One base in the DNA strand is replaced with another base.</p> <p>b) Silent, as there is no change to the polypeptide.</p>		
	3	<table border="0"> <tr> <td style="vertical-align: top;"> <p>a) • AUG ACG CGU UUA GAG UGA • met–thr–arg–leu–glu (stop) • silent</p> <p>b) • AUG ACC CGU UAA GAG UGA • met–thr–arg (stop) • nonsense</p> <p>c) • AUG ACC CGA UUA GAG UGA • met–thr–arg–leu–glu (stop) • silent</p> </td> <td style="vertical-align: top;"> <p>d)* • AUG ACC CGU UGA GAG UGA • met–thr–arg (stop) • nonsense</p> <p>e) • AUG ACC CGU CCA GAG UGA • met–thr–arg–pro–glu (stop) • missense</p> <p>f) • AUG ACC CGU UUA GUC UGA • met–thr–arg–leu–val (stop) • missense</p> </td> </tr> </table>	<p>a) • AUG ACG CGU UUA GAG UGA • met–thr–arg–leu–glu (stop) • silent</p> <p>b) • AUG ACC CGU UAA GAG UGA • met–thr–arg (stop) • nonsense</p> <p>c) • AUG ACC CGA UUA GAG UGA • met–thr–arg–leu–glu (stop) • silent</p>	<p>d)* • AUG ACC CGU UGA GAG UGA • met–thr–arg (stop) • nonsense</p> <p>e) • AUG ACC CGU CCA GAG UGA • met–thr–arg–pro–glu (stop) • missense</p> <p>f) • AUG ACC CGU UUA GUC UGA • met–thr–arg–leu–val (stop) • missense</p>
	<p>a) • AUG ACG CGU UUA GAG UGA • met–thr–arg–leu–glu (stop) • silent</p> <p>b) • AUG ACC CGU UAA GAG UGA • met–thr–arg (stop) • nonsense</p> <p>c) • AUG ACC CGA UUA GAG UGA • met–thr–arg–leu–glu (stop) • silent</p>	<p>d)* • AUG ACC CGU UGA GAG UGA • met–thr–arg (stop) • nonsense</p> <p>e) • AUG ACC CGU CCA GAG UGA • met–thr–arg–pro–glu (stop) • missense</p> <p>f) • AUG ACC CGU UUA GUC UGA • met–thr–arg–leu–val (stop) • missense</p>		
		g) The mutated codon may act as a codon for the same amino acid (as many amino acids are coded for by more than one codon).		
		*Note: An early print-run of <i>Blitzing Biology 12</i> accidentally had the same question in Activity 3 (b) and (d). If your copy has this duplicated question, the answer for (b) and (d) is the answer above for (b).		
4	<table border="0"> <tr> <td style="vertical-align: top;"> <p>a) (i) • AUG CAA CGC UUU AAG UAG • met–gln–arg–phe–lys (stop)</p> <p>(ii) • AUG CAA UCG CUU UAA GUA G • met–gln–ser–leu (stop) • nonsense and frameshift</p> </td> <td style="vertical-align: top;"> <p>b) (i) • CUG GUU UCC UGCAACAGA UGA • leu–val–ser–cys–asn–arg (stop)</p> <p>(ii) • CUG GUU UUG CAA CAG AUG A • leu–val–leu–gln–gln–met • frameshift</p> </td> </tr> </table> <p>c) The reading frame translates the mRNA in triplets called codons. A base insertion or deletion can alter the pattern of codons, causing all bases further on to be read out of alignment – this is known as frameshift.</p> <p>d) No – since mRNA codons are read three bases at a time, the reading frame would not be affected by the removal of three bases. However, one or two amino acids would be missing/altered due to this mutation.</p> <p>e) Insertions and deletions tend to cause frameshift, altering all amino acids further on. In contrast, frameshift does not occur from substitutions. All of these mutations can occur in genes to result in dysfunctional proteins, though some substitution mutations are silent.</p>	<p>a) (i) • AUG CAA CGC UUU AAG UAG • met–gln–arg–phe–lys (stop)</p> <p>(ii) • AUG CAA UCG CUU UAA GUA G • met–gln–ser–leu (stop) • nonsense and frameshift</p>	<p>b) (i) • CUG GUU UCC UGCAACAGA UGA • leu–val–ser–cys–asn–arg (stop)</p> <p>(ii) • CUG GUU UUG CAA CAG AUG A • leu–val–leu–gln–gln–met • frameshift</p>	
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Chapter 6 [continued]

Section	Activity	Sample answers
6.4	1	<p>a) Point mutation.</p> <p>b) Base substitution.</p> <p>c) It differs by one amino acid (it has <i>Val</i> instead of a <i>Glu</i> at one position).</p> <p>d) It results in sickle shaped red blood cells and hence poor oxygen transport.</p> <p>e) Positive.</p> <p>f) Negative.</p> <p>g) Malaria is a strong selection pressure in sub-Saharan Africa, killing many individuals. Heterozygotes with one copy of the mutant sickle allele are less likely to catch malaria. Hence, they are positively selected for in sub-Saharan Africa, increasing the frequency of this allele in the gene pool.</p>
	2	<p>a) A point mutation involving bases being deleted in the myostatin gene.</p> <p>b) There are several incorrect amino acids due to frameshift occurring and the protein is too short due to a premature stop codon.</p> <p>c) Excessive muscle growth, known as being 'double-muscled'.</p>
	3	<p>a) CFTR gene</p> <p>b) The protein is unable to fold correctly and subsequently breaks down.</p> <p>c) Difficulty controlling salt movement in and out of cells, which affects mucous secretions in the lungs and intestines, and increased resistance to certain diseases, e.g. typhoid fever.</p>
	4	<p>a) A single base substitution in the regulatory region for the LCT gene.</p> <p>b) The lactase enzyme continues to be produced.</p> <p>c) Individuals can digest lactose, so can continue eating foods containing lactose (e.g. dairy products) without negative side effects.</p> <p>d) Non-coding [Note: The regulatory regions for genes are often outside of the gene itself, in non-coding regions ... see Section 6.1]</p> <p>e) An allele is an alternate form of a gene. This mutation is in a non-coding, regulatory region of DNA – not within a gene. So, it is not an allele.</p>
	5	<p>a) Germ-line mutation.</p> <p>b) No – the mutation occurred in one of their gametes, so would not have been expressed in any of their somatic cells, such as those in the eyes.</p>
6.5	1	<p>a) An individual can have an extra chromosome or is missing a copy of a chromosome.</p> <p>b) • deletion • duplication • translocation • inversion</p>

Chapter 6 [continued]

Section	Activity	Sample answers								
6.5	2	<table border="1"> <thead> <tr> <th>Type of mutation</th> <th>Inversion</th> <th>Duplication</th> <th>Deletion</th> </tr> </thead> <tbody> <tr> <td>Description of the change that has occurred</td> <td>A chunk of DNA has been inserted in the opposite direction</td> <td>A chunk of DNA has a second copy inserted.</td> <td>A chunk of DNA is removed from a chromosome.</td> </tr> </tbody> </table>	Type of mutation	Inversion	Duplication	Deletion	Description of the change that has occurred	A chunk of DNA has been inserted in the opposite direction	A chunk of DNA has a second copy inserted.	A chunk of DNA is removed from a chromosome.
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	Description of the change that has occurred	A chunk of DNA has been inserted in the opposite direction	A chunk of DNA has a second copy inserted.	A chunk of DNA is removed from a chromosome.						
	3	<ul style="list-style-type: none"> TOP DIAGRAM: A chunk of DNA from chromosome 4 has translocated to a region within chromosome 20. This results in two mutated chromosomes, but no net change in the total genetic material present. BOTTOM DIAGRAM: Two translocation mutations have occurred in this diagram. A large chunk of chromosome 4 has translocated onto chromosome 20, while a smaller chunk of chromosome 20 has translocated onto chromosome 4. 								
	4	<p>a) (i) Unbalanced (iii) Balanced (ii) Unbalanced (iv) Balanced</p> <p>b) Unbalanced – these involve the gain or loss of genes, so are more likely to interfere with the normal protein production required for the correct functioning of an organism.</p>								
	5	<ul style="list-style-type: none"> homologous chromosomes pair genes different variation 								
6	<p>a) If crossing-over involves exchanging differing amounts of genetic material, then the result will be one homologous chromosome with missing genetic material – a deletion mutation, and the other homologous chromosome with duplication of a region.</p> <p>b) Non-homologous chromosomes engaging in crossing over during meiosis can allow translocation to occur, as it allows parts of chromosomes to go to new locations on non-homologous chromosomes.</p> <p>c)  </p>									

Chapter 6 [continued]

Section	Activity	Sample answers												
6.6	1	<ul style="list-style-type: none"> • extra • missing • 46 • 22 • 2 • XY • abnormality • 10,000 • chromosome • intellectual • risk • autosomal • miscarriage 												
	3	<p>a) If both identical twins are heterozygous for colour-blindness, then their eye cells can differ in the trait due to X-chromosome inactivation occurring after they separate during embryonic development.</p> <p>b) Most women have one X-chromosome become inactivated in their cells. This process means extra X chromosomes can be inactivated, and missing X chromosomes do not significantly impact on protein production.</p>												
	4	<p>a) Increased aggression, being more likely to commit crime, being tall, and poor mental health.</p> <p>b) Popular media myths about XYY became widely accepted and biased those who were conducting research into XYY.</p> <p>c) Prison inmates and hospital patients are not likely to be representative of the general population, e.g. certain demographics and socioeconomic backgrounds can be more common in prison inmates and certain personality traits may be more common (e.g. aggression).</p>												
	5	<p>a) <i>From top to bottom: 2, 4, 1, 3</i></p> <p>b)</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 30%;"><i>Diagram</i></td> <td></td> <td></td> </tr> <tr> <td><i>Number of gametes with numerical abnormalities</i></td> <td>4</td> <td>2</td> </tr> <tr> <td><i>Type of nondisjunction (homologous chromosomes OR sister chromatids)</i></td> <td>Homologous chromosomes</td> <td>Sister chromatids</td> </tr> <tr> <td><i>When did the error occur? (Meiosis I or II)</i></td> <td>Meiosis I</td> <td>Meiosis II</td> </tr> </table> <p>c) <i>See diagrams in table above – a normal gamete will have only 2 chromosomes. If the gamete has 3 chromosomes, then trisomy (T) could occur after fertilisation. If the gamete has 1 chromosome, then monosomy (M) could occur after fertilisation.</i></p>	<i>Diagram</i>			<i>Number of gametes with numerical abnormalities</i>	4	2	<i>Type of nondisjunction (homologous chromosomes OR sister chromatids)</i>	Homologous chromosomes	Sister chromatids	<i>When did the error occur? (Meiosis I or II)</i>	Meiosis I	Meiosis II
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Chapter 6 [continued]

Section	Activity	Sample answers																							
6.6	5	<p>d) Yes – sister chromatids need to separate correctly during mitosis. Failure to do so correctly will cause nondisjunction and result in daughter cells with abnormal chromosome numbers.</p> <p>e) During embryonic growth via mitosis (i.e. it is post the zygote stage).</p>																							
	6	<p>a) Maternal age</p> <p>b) Risk of Down syndrome at birth (%) and risk of chromosomal abnormality at birth (%)</p> <p>c) Continuous</p> <p>d) Line</p> <p>e)</p> <div style="text-align: center;"> <p><i>Chromosomal abnormalities in births at different maternal ages</i></p> <table border="1"> <caption>Approximate data points from the graph</caption> <thead> <tr> <th>Maternal age (years)</th> <th>Risk of Down syndrome (%)</th> <th>Risk of a chromosomal abnormality (%)</th> </tr> </thead> <tbody> <tr><td>20</td><td>0.05</td><td>0.05</td></tr> <tr><td>25</td><td>0.05</td><td>0.05</td></tr> <tr><td>30</td><td>0.05</td><td>0.05</td></tr> <tr><td>35</td><td>0.1</td><td>0.1</td></tr> <tr><td>40</td><td>0.5</td><td>0.5</td></tr> <tr><td>45</td><td>2.5</td><td>4.0</td></tr> <tr><td>48</td><td>7.0</td><td>10.0</td></tr> </tbody> </table> <p> x Risk of Down syndrome at birth (%) x Risk of a chromosomal abnormality at birth (%) </p> </div> <p>f) As maternal age increases over 35 years, the risk of chromosomal abnormalities in offspring significantly (exponentially) increases.</p>	Maternal age (years)	Risk of Down syndrome (%)	Risk of a chromosomal abnormality (%)	20	0.05	0.05	25	0.05	0.05	30	0.05	0.05	35	0.1	0.1	40	0.5	0.5	45	2.5	4.0	48	7.0
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48	7.0	10.0																							
6.7	1	<p>Types of point mutations:</p> <ul style="list-style-type: none"> • Substitution (which can be silent, missenses or nonsense) • Insertion (usually causes frameshift) • Deletion (usually causes frameshift) <p>Types of chromosome mutations:</p> <ul style="list-style-type: none"> • Numerical abnormalities (e.g. monosomy, trisomy) • Structural abnormalities (e.g. insertion, deletion, translocation and inversion) 																							

Chapter 6 [continued]

Section	Activity	Sample answers															
6.7	2	<table border="1"> <thead> <tr> <th><i>Cause of mutation</i></th> <th><i>Is a point or chromosome mutation more likely?</i></th> <th><i>Reason for your response</i></th> </tr> </thead> <tbody> <tr> <td>A cell is exposed to ultraviolet light</td> <td>Point</td> <td>UV light can cause dimers to form, which affect individual bases (not large parts of chromosomes).</td> </tr> <tr> <td>A cell has errors occur during DNA replication</td> <td>Point</td> <td>Errors during DNA replication are more likely to involve errors in base pairings (point mutations) than errors in significant parts of or entire chromosomes.</td> </tr> <tr> <td>Nondisjunction occurs during meiosis</td> <td>Chromosome</td> <td>Failure of homologous chromosomes (or sister chromatids) to separate properly will cause changes to large parts of or entire chromosomes.</td> </tr> <tr> <td>A cell is exposed to hydrogen peroxide</td> <td>Point</td> <td>This is a mutagenic chemical that can interfere with correct base pairings (so causes a point mutation).</td> </tr> </tbody> </table>	<i>Cause of mutation</i>	<i>Is a point or chromosome mutation more likely?</i>	<i>Reason for your response</i>	A cell is exposed to ultraviolet light	Point	UV light can cause dimers to form, which affect individual bases (not large parts of chromosomes).	A cell has errors occur during DNA replication	Point	Errors during DNA replication are more likely to involve errors in base pairings (point mutations) than errors in significant parts of or entire chromosomes.	Nondisjunction occurs during meiosis	Chromosome	Failure of homologous chromosomes (or sister chromatids) to separate properly will cause changes to large parts of or entire chromosomes.	A cell is exposed to hydrogen peroxide	Point	This is a mutagenic chemical that can interfere with correct base pairings (so causes a point mutation).
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3	<ul style="list-style-type: none"> • Only germ-line mutations can be inherited, possibly creating new alleles. • Germ-line mutations do not impact the individual in which they occur. • Somatic mutations can have no impact on the individual in which they occur or can have a significant impact, e.g. causing cancer. 																
4	Mutations within coding DNA are more likely to impair the correct formation of proteins, as genes in this DNA encode for proteins. Mutations in non-coding regions often do not impact proteins. However, if a regulatory region is involved, they can impact protein production.																
5	<p>a)</p> <ul style="list-style-type: none"> (i) Coding (ii) Germ-line (iii) Yes (iv) Yes <p>b) A germ-line mutation must occur in a coding region of DNA. The mutation cannot be silent. The gamete with the mutation needs to join with another gamete to form a new individual. This mutated gene is a new allele. The individual must survive to reproduce and pass the allele on to their offspring for the allele to remain in the population.</p>																

Chapter 6 [continued]

Section	Activity	Sample answers												
6.7	6	<p><i>Multiple correct answers, e.g.</i></p> <table border="1"> <thead> <tr> <th>EXAMPLES</th> <th>Down syndrome</th> <th>Sickle cell anaemia</th> </tr> </thead> <tbody> <tr> <td><i>What change occurs in the DNA?</i></td> <td>An additional copy of chromosome 21.</td> <td>A single base is substituted with an incorrect base.</td> </tr> <tr> <td><i>What type of mutation is this categorised as?</i></td> <td>Chromosome mutation (numerical abnormality)</td> <td>Point mutation (base substitution causing missense).</td> </tr> <tr> <td><i>How does this affect phenotype?</i></td> <td>Distinctive physical characteristics, varied levels of intellectual disability and increased risk of certain health problems</td> <td>Abnormal haemoglobin proteins are produced, leading to crescent (sickle) shaped blood cells that have reduced ability to transport oxygen effectively.</td> </tr> </tbody> </table>	EXAMPLES	Down syndrome	Sickle cell anaemia	<i>What change occurs in the DNA?</i>	An additional copy of chromosome 21.	A single base is substituted with an incorrect base.	<i>What type of mutation is this categorised as?</i>	Chromosome mutation (numerical abnormality)	Point mutation (base substitution causing missense).	<i>How does this affect phenotype?</i>	Distinctive physical characteristics, varied levels of intellectual disability and increased risk of certain health problems	Abnormal haemoglobin proteins are produced, leading to crescent (sickle) shaped blood cells that have reduced ability to transport oxygen effectively.
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6.8	2	<p><i>Many approaches can be used by students to appropriately address this extended response.</i></p> <p><i>Suggested marking criteria include:</i></p> <ul style="list-style-type: none"> • Students' responses make clear points that use biological terms correctly and demonstrate an understanding of the key words in the question (germ-line, mutations, variation, alleles) • Students' responses use specific examples to support their points • Students' explain how their examples support their points 												

Chapter 7

Section	Activity	Sample answers
7.1	1	<p>a) >10%</p> <p>b) <90%</p> <p>c) >99%</p> <p>d) There would be a slight increase in the percentage frequency of H^S and a slight decrease in the percentage frequency of H^N.</p>
	2	<p>1:2, 2:3, 3:5, 4:1, 5:4</p> <p><i>i.e. the definitions from top to bottom are:</i></p> <ul style="list-style-type: none"> • allele frequency • population • gene pool • sexual reproduction • mutation
	3	<p>The allele(s) for that specific gene are selected as the associated trait is better suited to the environment. Those individuals with this trait survive to reproduce and pass on that allele(s). So, the frequency of these allele(s) in the population increases over time.</p> <p>[Note: Similarly, the allele(s) for a gene that cause a phenotype that is selected against will have a lower allele frequency over time.]</p>
	4	<p>Males with long noses are more likely to be chosen as mates. Due to this sexual selection, these males reproduce and pass on their alleles for a long nose to their offspring. So, these allele(s) for a long nose have become more common in their population over time, thus increasing their allele frequency.</p>
	5	<p>This interbreeding is likely to introduce new alleles to the population's gene pool. This will change the allele frequency and so increase their genetic diversity.</p> <p>[Note: This change is described as 'gene flow' as it is not due to other factors, such as mutation or natural selection.]</p>
7.2	2	<p>a) • allele • random chance</p> <p>b) If the gene pool becomes reduced in some traits, e.g. brown fur, due to random chance, there will be significant changes to their allele frequency. For example, there will be a low frequency of alleles in the gene pool for fur colours other than brown.</p> <p>c) The chosen adults will not be representative of the wider human population. For example, by only choosing healthy adults, a number of genetically inherited diseases will be absent. It would also not be representative of the racial diversity present on Earth.</p>
7.3	1	<p>a) White and brown</p> <p>b) B and b</p> <p>c) 2</p> <p>d) 10</p> <p>e) $10/20 = 50\%$</p> <p>f) 50%</p>

Chapter 7 [continued]

Section	Activity	Sample answers
7.3	1	<p>g) (i) $14/20 = 70\%$ (ii) 30%</p> <p>h) The allele frequencies would become 100% for <i>B</i> and 0% for <i>b</i>.</p> <p>i) It is genetic drift as the changes in allele frequency are due to random chance. It is not natural selection as the changes are not due to the alleles being associated with a phenotype that has a survival advantage.</p> <p>j) Gene flow through one or more new rabbits migrating into the population could reintroduce the <i>b</i> allele to the population, leading to gradual changes in the allele frequency over time. A germ-line mutation could create an inheritable new allele for this particular gene.</p>
7.4	1	<p>a) Around 3 billion</p> <p>b) A single nucleotide polymorphism</p> <p>c) SNP</p> <p>c) Base substitution mutations</p> <p>d) 10,000</p>
	2	<p>a) It must occur in 1% or more of the population</p> <p>b) No</p> <p>c) <ul style="list-style-type: none"> An allele is a variant for a gene, so occurs in a coding region. A SNP can be in a coding or non-coding region. An allele may involve multiple differences in base sequence, whereas a SNP is only one base substitution </p> <p>d) 4</p>
	3	<p>a) Single-nucleotide polymorphism</p> <p>b) • GTCCTGGAC • GTCCCGGAC • GTCCGGGAC</p> <p>c) One of the possible combinations of SNPs in a given sequence of DNA.</p> <p>d) • GTCACGGC • GTCACGGGC • GTCGCGGCC • GTCGCGGGC</p> <p>e) (i) 12 (ii) Around 88%</p> <p>[Note: This is determined using the pie chart in the interactive activity, which shows the relative frequencies of several common SNP profiles found in asthmatics (A, B, C, D, E and other). You can visually estimate the % frequency or quantitatively calculate the percentage frequency. The 'other' section is approximately 45° (or $\frac{1}{8}$). This represents 12.5% (as $45^\circ/360^\circ = 0.125$). So, SNP profiles A–E occur in around 88% of asthmatics.]</p>

Chapter 7 [continued]

Section	Activity	Sample answers
7.4	3	<p>(iii) Albuterol has varying efficacy depending on a person's SNP profile, e.g. for the profiles given, albuterol effectively treats patients with SNP profiles B and E, fairly treats those with C and does not work for A and D.</p> <p>f) This could assist scientists as they examine how these influence traits and so lead to more specialised and effective medical treatments, e.g. some SNPs have been shown to influence the efficacy of the drug albuterol.</p>
7.5	2	<p>a) DNA sequencing is the process of determining the order of nucleotide bases (A, T, C and G) in a stretch of DNA.</p> <p>b) Sequenced the 3 billion bases of the entire human genome and identified each human gene.</p> <p>c) Improvements in DNA sequencing technologies made the sequencing faster and cheaper.</p> <p>d) <i>There are multiple correct answers, e.g.</i></p> <ul style="list-style-type: none"> • To identify how genetic factors contribute to observed traits. • To help identify genetic causes of disease. • It may be able to be used for improved, personalised medicines. • It may improve diagnosis of and screening for diseases. • To identify people with greater risk of certain conditions (e.g. diabetes) and to encourage preventative behaviours. • To aid forensics, e.g. accurate identification of suspects in criminal cases and/or to help identify family relationships.
	3	<ul style="list-style-type: none"> • sequencing • short • computer • copies • enhances • bind • difference • colour • order
7.6	2	<p>a) <i>Any TWO of the following:</i></p> <ul style="list-style-type: none"> • To settle paternity disputes • Comparing suspects to the DNA collected from a crime scene • Immigration disputes • To catch people who are illegally selling banned wildlife species <p>b) The VNTRs and STR vary in length between individuals due to the different number of repeats.</p> <p>c) Length</p>
	3	1, 4, 3, 2
	5	<p>a) 1000 bp</p> <p>b) 200 bp</p> <p>c) 90 bp</p> <p>d) 250 bp</p> <p>e) The shorter the length of the DNA fragment, the further it travels.</p>

Chapter 7 [continued]

Section	Activity	Sample answers
7.6	6	<p><i>There are many correct labels. Your labels can differ to these, as long as they give details of the process of gel electrophoresis.</i></p> <p><i>Labels may include:</i></p> <ul style="list-style-type: none"> • A sample is collected, e.g. blood, and the DNA is extracted from it. • DNA is extracted and cut into strands of different lengths. • Micropipette is used to place DNA samples in a gel electrophoresis apparatus. • An electrical current is applied to the gel. • The DNA strands move through the gel from each well – with the smaller length DNA strands moving further than the longer DNA strands. • The gel is stained to make the results more visible.
7.7	1	Males always inherit their Y-chromosome from their father, while all children inherit their mitochondrial DNA from their mother. These DNA regions have very little change between generations, allowing ancestry to be traced.
	2	<p>a) (i) Fewer (ii) More</p> <p>b) DNA analysis of mtDNA suggests Neandertal and humans diverged around 450,000 years ago. This shows that Neandertals are not closely related to any groups of modern humans.</p> <p>[Note: This relationship was determined by counting the number of mutations (regions of difference) between mtDNA in Neandertals and humans.]</p>
7.8	1	Sequencing of koala DNA gives insight into their immune genes and how koalas respond to diseases that are threatening their populations. It will also enable the genetic diversity within individuals and in populations to be examined to improve koala breeding programs.
	2	<p>Samples would need to be obtained from the possums, e.g. blood or tissue samples. DNA would need to be extracted from these samples and amplified. Gel electrophoresis could then be used to compare 'DNA fingerprints' ('DNA profiles') to find a possible paternal match, based on comparative lengths of target DNA sections, e.g. STRs.</p> <p>[Note: Alternatively, DNA sequencing could be used to compare the sequence of certain regions (e.g. STRs) to find a paternal DNA match.]</p>
	4	a) DNA profiling was used to provide evidence that the ivory found in the poachers' truck was taken from the dead Garamba Park elephants, and not from the elephants in one of the other two parks.

Chapter 7 [continued]

<i>Section</i>	<i>Activity</i>	<i>Sample answers</i>
7.8	4	<p>b) (i) STR markers that were known to be useful in differentiating between the alleles common in different elephant populations were analysed, to find the most likely ivory source.</p> <p>(ii) Different populations are exposed to different selection pressures, which influences the allele frequency. Also, genetic drift can occur, causing gradual changes to allele frequency due to random chance. A mutation may also occur to create a new allele in a population.</p> <p>c) Population genetics has been used to identify the regions where seized ivory has been poached, to then enable law enforcement efforts to focus time and budget on reducing poaching in these regions.</p> <p>d) Population genetics has a valuable role in helping to identify specific regions in Africa from which the ivory originated. However, population genetics alone cannot save elephant populations. International collaboration is essential to reducing illegal trafficking. Authorities involved in legislation, exportation and importation in multiple countries must openly share information and work together to help stop ivory trade and elephant poaching in Africa.</p>

Chapter 8

Section	Activity	Sample answers
8.1	–	<i>There are no sample answers provided for these sections, as your responses should reflect your own opinions and the findings of your own research.</i>
8.2		
8.3	1	<p>a) It is a genetically engineered (GE) to grow to market size in half the usual time. It has a growth-hormone gene from Chinook Salmon, plus gene regulators from an eel species – so it continually produces low levels of growth hormone.</p> <p>b) <i>There is no sample answer provided – as this is an opinion-based answer.</i></p> <p>c) The labelling of the salmon as GE might reduce AquaBounty’s sales due to people’s fears and so reduce their profits on this product.</p>
8.4	–	<i>There are no sample answers provided for this section, as your responses should reflect your own opinions and the findings of your own research.</i>

Chapter 9

Section	Activity	Sample answers
9.1	2	<p>Your groups should be logical and clearly indicated using a key.</p> <p>Apart from medicine, some other groups you could have used include:</p> <ul style="list-style-type: none"> • food/drink products • clothing related products • non-edible products
	3	<p><i>Definition:</i> “the manipulation (as through genetic engineering) of living organisms or their components to produce useful usually commercial products (such as pest resistant crops, new bacterial strains, or novel pharmaceuticals)”</p> <p><i>Source:</i> Merriam-Webster online dictionary, accessed via https://www.merriam-webster.com/dictionary/biotechnology</p>
	4	<p>DESCRIPTION OF WHAT IT IS:</p> <ul style="list-style-type: none"> • Biotechnology is the manipulation of living organisms and/or parts of living organisms in a vast range of products and processes • Modern biotechnology often uses cells as ‘factories’ to produce useful proteins, which can then be used in industrial applications, food or medicine. <p>EXAMPLES OF WHAT IT IS:</p> <ul style="list-style-type: none"> • <i>Any of the examples provided in Activity 1 – there are many other possible answers in addition to these.</i> <p>DESCRIPTION OF WHAT IT IS NOT:</p> <ul style="list-style-type: none"> • <i>There are multiple correct answers, e.g.</i> Biotechnology is not entirely natural, nor entirely artificial; biotechnology is not non-living machines; biotechnology is not inherently evil. <p>EXAMPLES OF WHAT IT IS NOT:</p> <ul style="list-style-type: none"> • <i>There are multiple correct answers, e.g.</i> It is not a non-living machine, a singular object or process.
	5	<p>a) It uses a bacterial species (a living organism) that secretes a protein that binds to dissolved gold. This protein allows the gold to be extracted from mining wastes and helps to reduce pollution from the wastes.</p> <p>b) <ul style="list-style-type: none"> • It could help to reduce the toxic outputs of mining wastes. • It could help to supply gold for industrial and/or fashion applications. </p>
	6	<p>a) It involves using horses (a living organism) as a ‘biological factory’ for making antibodies against snake venom. This antivenom can then be used by humans to treat snake bites.</p> <p>b) This has a positive impact on society, providing a useful medical treatment that reduces the impact of snake bites in human populations.</p>

Chapter 9 [continued]

Section	Activity	Sample answers
9.3	2	<ul style="list-style-type: none"> a) Goat b) Human c) AT-III protein. d) AT-III helps ensure that blood does not clot. e) A goat milk specific promoter. f) From human blood donations. g) (1) They naturally produce high volumes of milk . (2) They have relatively short generational times (18 months).
	3	<ul style="list-style-type: none"> a) Very similar. The amino acid sequence for the AT-III protein is determined by codons in the mRNA, which have been determined by the DNA sequence in the gene. The inserted human DNA sequence should be transcribed into the same mRNA as occurs in humans and translated into the same amino acid sequence as occurs in humans. b) No. A milk specific promoter has been inserted along with the human gene for AT-III. This promoter should ensure that the AT-III protein is only produced in the milk. c) <i>No sample answer – as this is an opinion-based question.</i> Ensure you have stated clearly whether you ‘agree’ or ‘disagree’ and then provided a clear reason for your opinion. d) <i>No sample answer – as this is an opinion-based question.</i> Ensure you have stated your opinion (e.g. This is wasteful OR This is important for safety) and then provided reasons to support your opinion and showing your scientific understanding.
9.4	2	<ul style="list-style-type: none"> <li style="width: 50%;">1) B <li style="width: 50%;">5) A <li style="width: 50%;">2) D <li style="width: 50%;">6) B <li style="width: 50%;">3) A <li style="width: 50%;">7) D <li style="width: 50%;">4) C <li style="width: 50%;">8) A
	3	<ul style="list-style-type: none"> a) T b) F c) T d) T e) T f) F g) F h) F i) T j) T

Chapter 9 [continued]

Section	Activity	Sample answers								
9.4	4	<p>a) Roundup kills normal crops as well as weeds. So, using Monsanto seeds that are Round-up resistant allows farmers to use Roundup effectively in the control of weeds without harming their crop. This improves crop yield, while reducing time to manage weeds.</p> <p>b) <ul style="list-style-type: none"> • They were the first company to develop these types of crops. • The crops are useful and so became popular. • Monsanto have used legal patents and sterile seeds to help them get repeat purchases from farmers. • The transgenic seeds encourage further sales of Roundup herbicide. </p> <p>c) <i>No sample answer as this is an opinion-based question.</i> Ensure you have stated clearly whether you think their behaviour is ethical or is unethical, and then provided clear reasons for your opinion.</p> <p>d) If random mutations cause a given weed species to develop glyphosate resistance, these weeds will survive in the presence of Roundup. This resistance will be passed onto future generations, causing glyphosate resistance to become more common in the population.</p> <p>e) A given weed species may have a mutation occur that enables it to survive one herbicide, such as Roundup, but may then die from the next herbicide used. This reduces the ability of the mutant to pass the favourable trait onto its offspring.</p>								
9.5	2	<table border="1"> <thead> <tr> <th>Regular pigs</th> <th>Enviropig</th> </tr> </thead> <tbody> <tr> <td>Pigs</td> <td>Pigs, bacteria and mice</td> </tr> <tr> <td>Low</td> <td>High</td> </tr> <tr> <td>High</td> <td>Low</td> </tr> </tbody> </table>	Regular pigs	Enviropig	Pigs	Pigs, bacteria and mice	Low	High	High	Low
	Regular pigs	Enviropig								
Pigs	Pigs, bacteria and mice									
Low	High									
High	Low									
	3	<p>a) <i>Genetic change:</i> A phytase gene was inserted into Enviropig from <i>E. coli</i> bacteria and a promotor gene sequence from mice. <i>Phenotypic change:</i> Enviropigs produced phytase enzymes in their saliva, allowing the digestion of phytate (a form of phosphorus) in food.</p> <p>b) Both the Enviropig and commercial phytase feed additives involve a transgenic species producing phytase due to an inserted phytase gene. However, the Enviropig involves phytase production in a transgenic pig, while the feed additive uses a transgenic fungus species.</p> <p>c) <i>No sample answer as this is an opinion-based question.</i> Ensure you have stated a clear 'yes' or 'no' to answer the question. You should then have provided clear reasons for your opinion.</p> <p>d) <i>Some examples:</i> <ul style="list-style-type: none"> • Education campaigns to improve consumer understanding of GM foods. • Simplification and communication of the results from scientific studies of the safety of meat from the Enviropig. • Independent research being conducted on the meat's safety. </p>								

Chapter 9 [continued]

Section	Activity	Sample answers
9.6	1	<p>a)</p> <ul style="list-style-type: none"> • Fuel for vehicles • Food for livestock • Absorption of excess CO₂ emissions from traditional fuel generators. <p>b) The information is not reliable and should be cross-checked for accuracy against more reliable sources. The lack of reliability is due to the information being presented by journalists (without any known scientific expertise) and by a businessman with a vested interest in presenting his company positively. This introduces bias to the information.</p>
	2	<p>a) Some microbes have naturally evolved to consume oil as a food source. Other microbes can consume oil that has been transformed into plastics. These natural species help to reduce the impacts of oil/plastic pollution.</p> <p>b) Genetic engineering could potentially increase the rate at which microbes consume plastic wastes or oil spills, to make them more efficient at 'cleaning up' human pollution.</p>
9.7	2	<ul style="list-style-type: none"> • proteins • silk • steel • bullet • immune • bodies • properties • industrial • difficult • predatory • killing • milk • alternative • decades • goats • modified • genes • transgenic • bacteria
	3	<p>a) Germany</p> <p>b) 2008</p> <p>c) In both gel and bead forms, the silk can provide a non-plastic and non-animal product that is breathable and suitable as an ingredient in a variety of skin/hair care products, colour cosmetics and fragrances.</p> <p>d) Biosteel fibres can be used in a variety of fabric applications, e.g. car interiors, furniture upholstery and clothing. The fibers are biodegradable, soft & smooth, discourage bacterial growth and are breathable.</p> <p>e) AMSilk can be used as a non-toxic coating on objects to go in the body (e.g. breast implants), offering biocompatibility, slow biodegradation and reduced biofilm formation. It can also provide these qualities alongside design flexibility for surgical meshes and wound dressings.</p>
	4	<p>a) Genetically engineered (GE) <i>E.coli</i> bacteria [OR Transgenic <i>E.coli</i> bacteria]</p> <p>b) 3, 2, 4, 1</p>

Chapter 9 [continued]

Section	Activity	Sample answers									
9.7	6	<p><i>There are multiple correct answers that you could have written. Some different ideas that you may have included are provided below.</i></p> <p><i>[Note: You did not need, nor have the space to include as many ideas as are shown here.]</i></p> <table border="1"> <thead> <tr> <th></th> <th>Economic advantages</th> <th>Economic disadvantages</th> </tr> </thead> <tbody> <tr> <td>Transgenic goats</td> <td> <ul style="list-style-type: none"> Produce silk in large quantities in their milk Can be selectively bred to improve traits related to silk production efficiency over time. Relatively easy to access the silk proteins by milking the goats </td> <td> <ul style="list-style-type: none"> Requires suitable farm land and feedstock Generation times are longer than for bacteria May have more regulatory costs relative to transgenic bacteria </td> </tr> <tr> <td>Transgenic bacteria</td> <td> <ul style="list-style-type: none"> More rapid silk production than goats Rapid breeding rates </td> <td> <ul style="list-style-type: none"> Silk is produced in smaller quantities than goats Requires large vats (or similar) to grow bacteria and machinery to purify/harvest the silk proteins. </td> </tr> </tbody> </table>		Economic advantages	Economic disadvantages	Transgenic goats	<ul style="list-style-type: none"> Produce silk in large quantities in their milk Can be selectively bred to improve traits related to silk production efficiency over time. Relatively easy to access the silk proteins by milking the goats 	<ul style="list-style-type: none"> Requires suitable farm land and feedstock Generation times are longer than for bacteria May have more regulatory costs relative to transgenic bacteria 	Transgenic bacteria	<ul style="list-style-type: none"> More rapid silk production than goats Rapid breeding rates 	<ul style="list-style-type: none"> Silk is produced in smaller quantities than goats Requires large vats (or similar) to grow bacteria and machinery to purify/harvest the silk proteins.
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9.8	2	<p>This source has moderate to high reliability. It was published recently (2017) and the author, Paul Willis, is listed as being experienced and qualified in Science. The information appears consistent with other information on genetic engineering. However, specific facts would need to be cross-checked with other reliable sources to further assess the reliability.</p>									

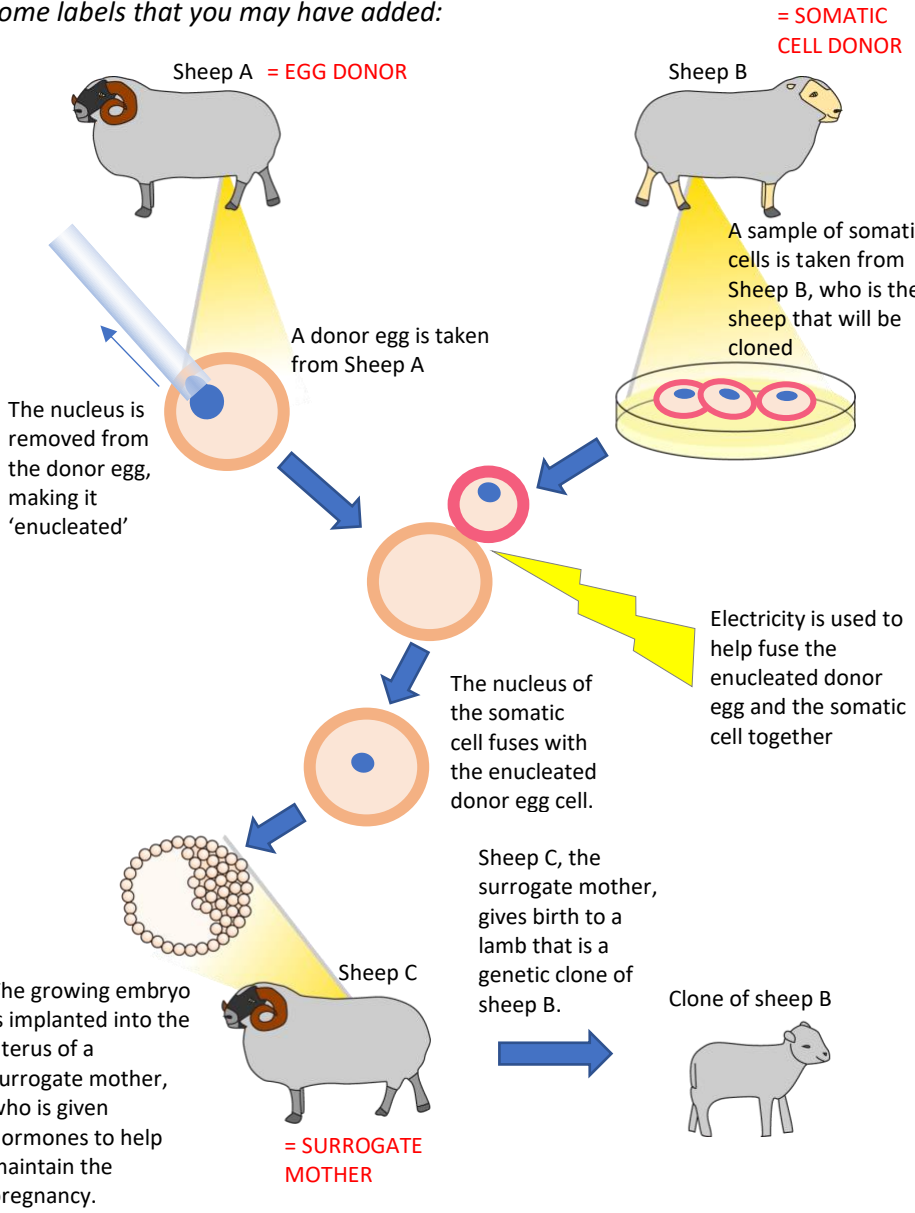
Chapter 10

Section	Activity	Sample answers
10.1	1	3, 4, 1, 2
	2	<p>a) Humans select the wanted trait rather than environmental selection pressures.</p> <p>b)</p>
	3	<p>a) (i) Round (ii) Round (iii) Wrinkled</p> <p>b) The allele frequency for <i>r</i> gradually decreased over 10 generations when selectively breeding for round peas. However, it did not reach zero.</p> <p>c) The allele frequency for <i>R</i> rapidly decreased to 0% in the second generation after selectively breeding for wrinkled peas.</p> <p>d) Selective breeding decreases genetic variation, making the allele associated with the selected trait more common in the population.</p>
	4	<p><i>There are multiple correct answers. You should have included at least two advantages and two disadvantages, e.g.</i></p> <p>ADVANTAGES: Selective breeding can be beneficial, e.g. in agriculture to improve the amount and quality of produce, such as in dairy cows that have been bred to have higher milk quantity and quality.</p> <p>DISADVANTAGES: Some selected traits are harmful for the species and have questionable ethics, such as bulldog facial traits that make breathing difficult.</p>
10.2	1	<p>a) <i>Multiple correct answers, including:</i></p> <ul style="list-style-type: none"> • number of branches • bushiness • number of kernels • presence / absence of casing around kernels • size of cob <p>b) Only 4 to 5 genes were responsible for the differences observed between maize (corn) and teosinte.</p> <p>c) Modern corn differs from a type of teosinte found in western Mexico around 9000 years ago, based on DNA differences and rate of mutation.</p> <p>d) Either by using fire to ‘pop’ the kernels out of their tough cases, or possibly by grinding the kernels with a stone.</p>
	2	<ul style="list-style-type: none"> • corn • products • farm • Mexico • teosinte • archaeological • modification • breeding • maize • analysis • similar • genes • phenotype • regulators

Chapter 10 [continued]

Section	Activity	Sample answers									
10.4	1	<p>a) AI is the manual insertion a male's semen into the vagina or uterus of a suitable female.</p> <p>b) As part of a fertility treatment.</p> <p>c) An artificial vagina.</p> <p>d) It is frozen.</p> <p>e) An insemination rod.</p> <p>f) (1) It can increase genetic variation in a herd. (2) It can introduce specific traits to the herd. (3) It is cheaper than keeping a herd bull for mating.</p> <p>g) Using AI can introduce new genetic material into the herd from distant, unrelated individuals, thus increasing genetic diversity.</p>									
	2	<p>a) Many of his genes for desirable traits have been widely inherited, e.g. beneficial traits such as good animal health and good milk production.</p> <p>b) It will have increased the allele frequency of Starbuck's desirable traits in the gene pool of dairy cows. This will have decreased the overall genetic diversity in dairy cows.</p>									
	3	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #c00000; color: white; text-align: center;"><i>Artificial pollination</i></th> <th style="background-color: #c00000; color: white; text-align: center;"><i>Artificial insemination</i></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Flowering plants</td> <td style="text-align: center;">Animals that reproduce sexually – usually domestic animals</td> </tr> <tr> <td style="text-align: center;">Brushing anthers to collect pollen</td> <td style="text-align: center;">Using an artificial vagina to collect semen</td> </tr> <tr> <td style="text-align: center;">Brushing stigma with pollen</td> <td style="text-align: center;">Inserting semen in vagina or uterus with insemination rod</td> </tr> <tr> <td style="text-align: center;">To selectively breed desired traits in plants.</td> <td style="text-align: center;">To selectively breed desired traits in animals.</td> </tr> </tbody> </table>	<i>Artificial pollination</i>	<i>Artificial insemination</i>	Flowering plants	Animals that reproduce sexually – usually domestic animals	Brushing anthers to collect pollen	Using an artificial vagina to collect semen	Brushing stigma with pollen	Inserting semen in vagina or uterus with insemination rod	To selectively breed desired traits in plants.
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10.5	2	<ul style="list-style-type: none"> • cloned • cell • SCNT • somatic • genetic • nucleus • removed • donor • fuse • transfer • enucleated • division • surrogate • hormones • contributed 									
	3	<p>1:2, 2:4, 3:5, 4:1, 5:3</p> <p><i>i.e. the definitions from top to bottom are:</i></p> <ul style="list-style-type: none"> • Clone • Somatic cell • Surrogate mother • Nucleus • Enucleated egg cell 									

Chapter 10 [continued]

Section	Activity	Sample answers
10.5	4	<p><i>Some labels that you may have added:</i></p>  <p>The diagram illustrates the process of somatic cell nuclear transfer. It starts with two sheep: Sheep A, labeled as the 'EGG DONOR', and Sheep B, labeled as the 'SOMATIC CELL DONOR'. From Sheep A, a donor egg is taken. The nucleus is removed from this egg, making it 'enucleated'. From Sheep B, a sample of somatic cells is taken. The nucleus of one of these somatic cells is fused with the enucleated donor egg cell using electricity. This fusion results in a single cell containing the genetic material of Sheep B. This cell develops into a growing embryo, which is then implanted into the uterus of Sheep C, the 'SURROGATE MOTHER'. Sheep C gives birth to a lamb, which is a genetic clone of Sheep B.</p>
6		<p>DNA in the offspring is from a single sperm fertilising a single egg. The genetic material has copied itself by mitosis and formed identical daughter cells with identical DNA. Hence these cloned cells result in genetically identical embryos.</p>

Chapter 10 [continued]

Section	Activity	Sample answers
10.5	7	<p>a) The hypothetical clone of their friend would need 9 months to develop, and then would be born as a baby and so too young for a Year 12 formal.</p> <p>b) <i>Multiple correct answers, e.g.</i></p> <ul style="list-style-type: none"> • Bacteria clone by binary fission. • Yeast clone by budding. • Some animals clone offspring via parthenogenesis. <p>c) Mr Biggles II is not Mr Biggles brought back to life. Rather, Mr Biggles II is a genetic clone of Mr Biggles and a newborn puppy. Memories and behavioural training are not transferred via DNA, and so could not be 'cloned' into Mr Biggles II.</p>
	9	<p>a) <i>Any THREE of the following:</i></p> <ul style="list-style-type: none"> • Fertilised eggs formed by SCNT often fail to grow by mitosis. • Inserted embryos formed from SCNT often miscarry. • It is time consuming as it often requires multiple attempts before a successful clone is produced. • It is expensive. <p>b) Cloning would ensure the transgenic trait was expressed in the offspring, while normal breeding may require many generations of breeding to successfully have the trait expressed (depending on the gene's dominance). This may make cloning more efficient than natural breeding.</p> <p>c) The genetics of the mice in the study will become a controlled variable. This eliminates a typical source of variation in animal models, and so will significantly improve the validity of the results.</p> <p>d) A somatic cell can be taken from the slaughtered, castrated bull to clone him using SCNT. Once his clone reaches maturity, sperm samples can be collected using artificial insemination to spread the original bull's genetics after his death.</p>
10.6	1	<p>a) The cells in the cutting have the same genetic material as the original plant and will grow by mitosis to form a clone of the original plant.</p> <p>b) The scion is the clone, as it will form the majority of the grafted plant and importantly has the ability to reproduce. The root stock will have identical DNA to the plant it came from, but cannot reproduce.</p>
	2	<p>a) They have only one source of DNA – the parent plant whose tissue was scraped. So, their DNA will be genetically identical to this plant.</p> <p>b) Plant clones made using tissue culturing – because the cloning of plants is not affected by issues, such as implantation or miscarriages, that affect animal clones made using SCNT.</p>


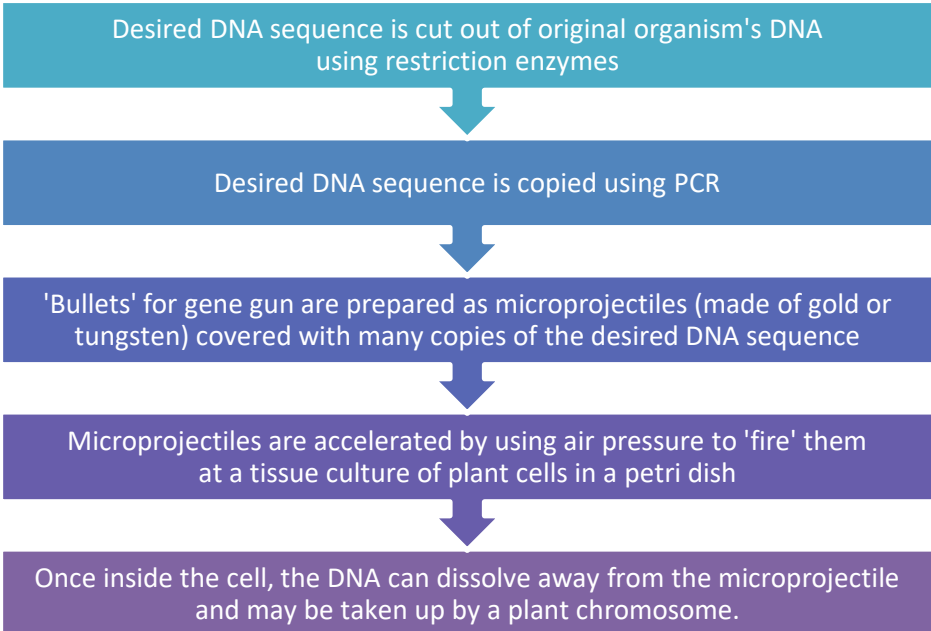
Chapter 10 [continued]

Section	Activity	Sample answers								
10.7	2	<table border="1"> <thead> <tr> <th>What is it?</th> <th>Why is it used in PCR?</th> </tr> </thead> <tbody> <tr> <td>Short, custom built sequences of DNA (usually about 20 nucleotides long).</td> <td>To attach to DNA at the target segment and to guide the DNA polymerase on where to start copying.</td> </tr> <tr> <td>Proteins that assist in copying DNA.</td> <td>It attaches to the target DNA segment at the point where the primers are located and continues copying the strand.</td> </tr> <tr> <td>The building blocks of DNA. Each nucleotide contains a sugar, a phosphate and a base (A, T, C or G).</td> <td>These are used to build the copies of the target DNA segment.</td> </tr> </tbody> </table>	What is it?	Why is it used in PCR?	Short, custom built sequences of DNA (usually about 20 nucleotides long).	To attach to DNA at the target segment and to guide the DNA polymerase on where to start copying.	Proteins that assist in copying DNA.	It attaches to the target DNA segment at the point where the primers are located and continues copying the strand.	The building blocks of DNA. Each nucleotide contains a sugar, a phosphate and a base (A, T, C or G).	These are used to build the copies of the target DNA segment.
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The building blocks of DNA. Each nucleotide contains a sugar, a phosphate and a base (A, T, C or G).	These are used to build the copies of the target DNA segment.									
3	<ul style="list-style-type: none"> • PCR 1. • sample • cellular 2. • tube 3. • thermal 4. • unwind 5. • cool • primers 6. • polymerase 7. • copied 8. • billion 									
4	<p>a) <ul style="list-style-type: none"> • original DNA to be replicated • many DNA nucleotides <ul style="list-style-type: none"> • DNA primer • DNA polymerase </p> <p>b) Heating is required to separate double-stranded DNA into two single strands. Cooling then enables the DNA primers to attach to the DNA template. Then heating enables the polymerase enzyme to add the complementary nucleotides to make the new strand of DNA.</p> <p>c) Its base order.</p> <p>d) PCR is a highly effective way to clone genes as it makes billions of copies in a short space of time at a relatively low cost. However, it is not able to produce copies of the proteins for which the gene clones encode.</p>									
10.8	1	<p>a) Yes</p> <p>b) No</p> <p>c) Yes</p> <p>d) Yes</p> <p>e) No</p>								

Chapter 10 [continued]

Section	Activity	Sample answers
10.8	2	1. C 2. D 3. B 4. C
	3	<ul style="list-style-type: none"> • recombinant • organism • engineering • genes • desired • growth • eel • rapidly • foreign • structure • regulators • methods • virus • pasting • nucleus • microinjection
	4	a) Recombinant deoxyribonucleic acid b) Genetic engineering OR genetically engineered c) DNA has the same molecular structure with the same bases. d) Another salmon species and an eel species. e) To ensure the desired gene is able to be transcribed. f) • gene gun • sharp micropipette g) A virus h) A bacterium
10.9	1	a) Into the DNA plasmid. b) A suitable gene regulator. c) They have recombinant DNA in them. d) By fission (OR by asexual reproduction). e) Yes f) <i>E. coli</i> g) The human gene for insulin, plus a suitable gene regulator for producing insulin.
	2	Gene clones made by PCR produce more copies of a gene in a shorter space of time relative to those made using recombinant DNA in bacteria. Both forms of gene cloning result in identical copies of the DNA sequence. However, the bacteria can produce the protein encoded by the gene, which does not occur in PCR, as PCR gene clones are not contained within cells.
	4	a) Bacterial plasmid b) Restriction enzyme c) Restriction enzyme <i>[Note: This is the same restriction enzyme as in (b).]</i> d) DNA ligase enzyme e) Into a bacterium.
	5	3, 2, 6, 1, 4, 5

Chapter 10 [continued]

Section	Activity	Sample answers
10.9	6	<p>a) 'Cuts': Restriction enzymes 'Pastes': DNA ligase</p> <p>b) Restriction enzymes create 'sticky ends' by cutting DNA at a specific sequence in such a way that DNA overhangs are left behind. These overhangs can bind with a complementary DNA strand cut by the same restriction enzyme.</p> <p>c) Using the same restriction enzyme ensures that the plasmid and the DNA sequence for insertion have complementary bases on their 'sticky ends' to allow recombination to occur.</p> <p>d) They are sealed using DNA ligase.</p> <p>e) </p>
10.10	1	<p>a) Bt genes for a natural pesticide.</p> <p>b) A soil bacterium (<i>Bacillus thuringiensis</i>)</p> <p>c) Caterpillar pests that damage cotton crops.</p> <p>d) Gold or tungsten</p> <p>e) Many copies of the bacterial DNA sequence.</p> <p>f) PCR</p> <p>g) Restriction enzymes</p> <p>h) Air pressure</p> <p>i) To achieve a functional transgenic organism that is expressing the gene(s) in the recombinant DNA as intended.</p>
	2	 <p>Desired DNA sequence is cut out of original organism's DNA using restriction enzymes</p> <p>Desired DNA sequence is copied using PCR</p> <p>'Bullets' for gene gun are prepared as microprojectiles (made of gold or tungsten) covered with many copies of the desired DNA sequence</p> <p>Microprojectiles are accelerated by using air pressure to 'fire' them at a tissue culture of plant cells in a petri dish</p> <p>Once inside the cell, the DNA can dissolve away from the microprojectile and may be taken up by a plant chromosome.</p>

Chapter 10 [continued]

Section	Activity	Sample answers										
10.10	4	<table border="1"> <thead> <tr> <th>Gene gun approach</th> <th><i>Agrobacterium</i> approach</th> </tr> </thead> <tbody> <tr> <td>Restriction enzymes</td> <td>Restriction enzymes</td> </tr> <tr> <td>Microprojectiles made of gold or tungsten</td> <td><i>Agrobacterium tumefaciens</i></td> </tr> <tr> <td>Microprojectiles are covered with many copies of the desired DNA sequence</td> <td>It is inserted into the Ti plasmid as recombinant DNA</td> </tr> <tr> <td>Microprojectiles are 'fired' using air pressure to accelerate them</td> <td><i>A. tumefaciens</i> can naturally insert its Ti plasmid into plant cells</td> </tr> </tbody> </table>	Gene gun approach	<i>Agrobacterium</i> approach	Restriction enzymes	Restriction enzymes	Microprojectiles made of gold or tungsten	<i>Agrobacterium tumefaciens</i>	Microprojectiles are covered with many copies of the desired DNA sequence	It is inserted into the Ti plasmid as recombinant DNA	Microprojectiles are 'fired' using air pressure to accelerate them	<i>A. tumefaciens</i> can naturally insert its Ti plasmid into plant cells
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Microprojectiles are 'fired' using air pressure to accelerate them	<i>A. tumefaciens</i> can naturally insert its Ti plasmid into plant cells											
5	<p>Many approaches can be used by students to appropriately address this extended response.</p> <p>Suggested marking criteria include:</p> <ul style="list-style-type: none"> • Students make an evaluative statement that makes a clear judgement of the impact of scientific knowledge on the manipulation of plant reproduction in agriculture. • Students' responses make clear points that use biological terms correctly and demonstrate an understanding of the key words in the question (plant reproduction, manipulation, agriculture, selectively bred, artificial pollination, cloning, genetic engineering). • Students' responses use specific examples to support their points. • Students' explain how their examples support their points. 											
10.11	1	1:2, 2:3, 3:1 <i>i.e. the definitions from top to bottom are:</i> <ul style="list-style-type: none"> • Ecosystem biodiversity • Genetic biodiversity • Species biodiversity 										
	2	<ul style="list-style-type: none"> • decrease • increase • increase • increase • decrease • decrease • increase 										

Module 7: Infectious Disease

Chapter 11

Section	Activity	Sample answers									
11.1	3	1:4, 2:1, 3:5, 4:3, 5:2 <i>i.e. the definitions from top to bottom are:</i> • disease • non-infectious disease • infectious disease • health • pathogen									
	4	a) Bacteria, virus, lice* b) Yes c) Infectious d) Non-infectious e) Cancer* f) The common cold* g) Tetanus* h) Cystic fibrosis* i) Sunburn* * There are many other possible correct answers. The answers provided are taken from the information provided in Activity 2.									
	5	<pre> graph LR CAUSES[CAUSES] --> Infectious[Infectious disease] CAUSES --> NonInfectious[Non-Infectious disease] Infectious --> Bacteria[Bacteria] Infectious --> Viruses[Viruses] Infectious --> Pathogens[and other types of pathogens ...] NonInfectious --> Genetics[Genetics] NonInfectious --> Environment[Environment] NonInfectious --> Cells[Cells malfunctioning] </pre>									
	6	<table border="0"> <tr> <td>a) Non-infectious</td> <td>f) Infectious</td> </tr> <tr> <td>b) Infectious</td> <td>g) Non-infectious</td> </tr> <tr> <td>c) Infectious</td> <td>h) Infectious</td> </tr> <tr> <td>d) Non-infectious</td> <td>i) Non-infectious</td> </tr> <tr> <td>e) Infectious</td> <td>j) Non-infectious</td> </tr> </table>	a) Non-infectious	f) Infectious	b) Infectious	g) Non-infectious	c) Infectious	h) Infectious	d) Non-infectious	i) Non-infectious	e) Infectious
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d) Non-infectious	i) Non-infectious										
e) Infectious	j) Non-infectious										

Chapter 11 [continued]

Section	Activity	Sample answers		
11.2	1	<ul style="list-style-type: none"> • causing • microscopic • bacteria • type • organisms • disease • mosquitoes • animals • fleas • macroscopic • pathogens • life • cells • cellular • alive • agents 		
	2	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> a) A disease-causing organism or agent. b) Bacteria, fungi, protozoa c) Unicellular, eukaryotic organisms (that are not plants, animals or fungi) d) Malaria </td> <td style="width: 50%; vertical-align: top;"> e) <i>Multiple possible answers, e.g. ticks, fleas, leeches</i> f) Viruses, prions g) Bacteria h) Infectious i) Size j) A fungus or a protozoan </td> </tr> </table>	a) A disease-causing organism or agent. b) Bacteria, fungi, protozoa c) Unicellular, eukaryotic organisms (that are not plants, animals or fungi) d) Malaria	e) <i>Multiple possible answers, e.g. ticks, fleas, leeches</i> f) Viruses, prions g) Bacteria h) Infectious i) Size j) A fungus or a protozoan
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	3	a) Bacteria and fungi b) Type of cell (prokaryotic vs eukaryotic) and size (bacteria are smaller). c) Presence of nucleic acid (viruses have a nucleic acid, prions do not) and size (viruses are larger). d) SMALLEST TO LARGEST: Prions, viruses, bacteria, protozoa, macroscopic parasites.		
	4	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> a) Bacterium b) Virus c) Prion d) Bacterium </td> <td style="width: 50%; vertical-align: top;"> e) Fungus (unicellular fungus) f) Macroscopic parasite g) Virus </td> </tr> </table>	a) Bacterium b) Virus c) Prion d) Bacterium	e) Fungus (unicellular fungus) f) Macroscopic parasite g) Virus
a) Bacterium b) Virus c) Prion d) Bacterium	e) Fungus (unicellular fungus) f) Macroscopic parasite g) Virus			
5	a) Bacteria. <i>Possible reasons include:</i> <ul style="list-style-type: none"> • Size (too large to be a virus, too small to be fungi) • Cellular (appears to be made of a single cell, i.e. unicellular organism) • No visible nucleus (suggests prokaryotic organism) b) Protozoa. <i>Possible reasons include:</i> <ul style="list-style-type: none"> • Size (microscopic, but too large to be virus, bacteria or prion) • Cellular (appears to be made of a single cell, i.e. unicellular organism) • Motility structures present (appears to have a ‘tail’ [flagellum]) c) Virus. <i>Possible reasons include:</i> <ul style="list-style-type: none"> • Size (smaller than prokaryotes, but too big to be a prion) • Non-cellular (does not look like a typical cell membrane) d) Fungi. <i>Possible reasons include:</i> <ul style="list-style-type: none"> • Size (microscopic but too large to be a virus/prion) • Cell walls (has structures that could be cell walls) • Shape (round shapes and branching shapes seen) 			

Chapter 11 [continued]

Section	Activity	Sample answers
11.3	2	<p>a) Direct contact b) Vector c) Direct contact* d) Indirect contact e) Vehicle f) Indirect contact g) Direct contact h) Direct contact i) Vehicle j) Vector k) Vehicle (you could also argue that this is a biological vector) l) Indirect contact</p> <div style="border: 1px solid black; padding: 5px; margin-left: 200px;"> <p>*assuming the coughed droplets immediately went into or onto Judy, this is direct transmission. However, you could argue that it is indirect transmission if a contaminated object were formed that transferred the pathogen to Judy. You could also argue that this is vehicle transmission if the droplets remained in the air for some time before infecting Judy.</p> </div>
	3	<p>1:2, 2:4, 3:1, 4:3, 5:5 <i>i.e. the definitions from top to bottom are:</i> • fomite • direct contact • vehicle transmission • indirect contact • vector transmission</p>
	4	<p>Both involve vector transmission. Fly – acts as a mechanical vector, as it transfers pathogens from one person’s faeces to the other person’s food. Mosquito – acts as a biological vector as it becomes infected itself in the process of transferring the pathogen between people.</p>
	5	<p><i>Some of the following ideas may have been used in your brainstorm:</i></p> <ul style="list-style-type: none"> • Observing strict personal hygiene • Covering mouth when coughing • Careful hand washing before preparing or eating food, after toileting, after touching pets, etc • Not sharing cups, plates or cutlery with other people • Using a tissue when sneezing • Avoid touching face unless hands are washed • Cooking food thoroughly • Ensuring fresh air flow occurs in rooms frequently occupied • Drinking bottled or treated water in countries where tap water is unsafe • Appropriately disposing of fomites, such as used tissues or used nappies • Using insect repellents • Wearing long-legged pants and long-sleeved tops to avoid insect bites • Sanitary disposal of urine, faeces and blood

Chapter 11 [continued]

Section	Activity	Sample answers
11.3	6	<p>a) <i>Multiple correct answers, e.g.</i></p> <ul style="list-style-type: none"> • Direct contact, e.g. neighbour coughing droplets directly onto you • Indirect contact, e.g. air hostess touches a cup from one passenger and transfers pathogens onto a ‘fresh’ cup for you to drink from • Vehicle transmission, e.g. airborne pathogens circulating via the air-conditioning of the plane • Vector transmission, e.g. a mosquito manages to get on the plane during boarding and transfers pathogens between passengers <p>b) Direct contact – the pathogen is physically transferred via body fluids, such as blood between the mother and baby.</p> <p>c) The individual and those around them will not be aware that they are sick or contagious, and so are less likely to use preventative hygiene measures to avoid transmission.</p> <p>d) Touching people and the environment allows direct and indirect transmission of infectious disease. Regular handwashing removes pathogens from hands, reducing the likelihood of disease transmission.</p>
11.4	Variables	<p>a) Method of cleaning hands (soap and water versus alcohol-based hand sanitiser).</p> <p>b) The number of microbes cultured on a nutrient agar plate.</p> <p>c) <i>Some of the constant variables you could have included:</i></p> <ul style="list-style-type: none"> • Length of time used for incubation • Type of agar plate used to culture microbes • Temperature and humidity in room at time of hand cleaning • Tape used to seal the plate • Incubation temperature used
	Risk	<p>a) Some of the microbes may be pathogenic. Keeping the plate securely sealed at all times reduces the risk of being infected by pathogenic organisms that may be present.</p> <p>b) Human pathogens are less likely to grow successfully at 30°C, so this reduces the likelihood of pathogens being present.</p>

Chapter 11 [continued]

Section	Activity	Sample answers
11.4	Discussion Questions	<p>a) No. Many bacteria and fungi are not pathogenic and so it is likely that some non-pathogenic species have grown on the plate.</p> <p>b) <i>Compare your results to your partner / class, or to those found in other similar studies – then determine whether your results are consistent or not with these.</i></p> <p>c) (i) This allowed a general pattern of results to be observed and allowed the reliability of individual plates to be assessed. (ii) <i>There are many possible answers. However, most will also introduce another variable that is not kept constant, e.g. have a partner clean one individual's left and right hand or conduct the experiment on two separate days.</i></p> <p>d) The results may not be applicable for microbes that do not grow on nutrient agar plates, nor for viruses.</p> <p>e) The results may not be applicable for microbes that grow at temperatures other than 30°C.</p> <p>f) <i>There are multiple correct answers to this question, e.g.</i></p> <ul style="list-style-type: none"> • Yes – staff are more likely to clean their hands regularly if gel sanitiser is conveniently available than if they have to go to a sink. • Yes – this is a cost-effective hand cleaning option compared to installing lots of sinks to allow soap and water to be used. • No – alcohol gel sanitiser is less effective than soap and water and so staff should be encouraged to wash their hands using soap and water.
11.5	1	<ul style="list-style-type: none"> • Water reservoirs are usually surrounded by national parks (this reduces contamination by pollutants) • Water is filtered, and filters are checked regularly • Small amounts of chlorine are added (this kills many pathogens) • Regular monitoring of filters and water purity is undertaken
	2	<p>a) Removed</p> <p>b) Removed</p> <p>c) Killed</p> <p>d) Killed</p> <p>e) Removed</p> <p>f) Killed</p>
	3	<p><i>Possible answers include:</i></p> <ul style="list-style-type: none"> • People or animal faeces may have been washed into the water. • Dead animals may be located upstream. • Industry water wastes may be put into the river upstream.

Chapter 12

Section	Activity	Sample answers												
12.1	1	<table border="1"> <thead> <tr> <th></th> <th><i>Miasma theory</i></th> <th><i>Germ theory</i></th> </tr> </thead> <tbody> <tr> <td><i>Cause of disease based on this theory</i></td> <td>'Bad' air (or vapour)</td> <td>Microbes</td> </tr> <tr> <td><i>When did this theory gain acceptance?</i></td> <td>Since ancient times in some countries. In the Middle Ages in other countries.</td> <td>Mid 1800s</td> </tr> <tr> <td><i>Is this theory accepted today?</i></td> <td>No</td> <td>Yes</td> </tr> </tbody> </table>		<i>Miasma theory</i>	<i>Germ theory</i>	<i>Cause of disease based on this theory</i>	'Bad' air (or vapour)	Microbes	<i>When did this theory gain acceptance?</i>	Since ancient times in some countries. In the Middle Ages in other countries.	Mid 1800s	<i>Is this theory accepted today?</i>	No	Yes
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2	<p>a) He was convinced that cholera was spread by contaminated water sources and had found from mapping a cholera outbreak that nearly everyone who died from it lived near the Broad Street water pump.</p> <p>b) An infant who died early in the cholera outbreak had had its nappies thrown into a cess pool beside the Broad Street pump.</p> <p>c) Louis Pasteur and Robert Koch.</p>													
1	<ul style="list-style-type: none"> • ancient • century • existence • mould • flies • frogs • grains • evidence • generation • disease • created 													
12.2	2	<p>a) The idea that life can come into existence from non-living matter, e.g. mud creates frogs, dust creates fleas, etc.</p> <p>b) <i>Multiple possible answers, e.g.</i> Maggots were thought to arise from decaying meat. However, in reality, the maggots hatch from very small fly eggs that have been previously laid on the meat.</p> <p>c) It fitted in with religious views that God created all life and so people could see no reason why life could not arise from inanimate objects. Also, without microscopes, scientists had no knowledge of microorganisms and lacked scientific evidence to disprove it until Pasteur.</p> <p>[Note: The belief in spontaneous generation delayed the formation of inferences that microbes were a cause and not an effect of disease.]</p>												

Chapter 12 [continued]

Section	Activity	Sample answers
12.2	3	<p>a) The way the containers were sealed (i.e. open, cork-sealed or gauze-covered)</p> <p>b) The number of maggots that were observed on the meat after time had passed.</p> <p>c) <i>Possible correct answers include:</i></p> <ul style="list-style-type: none"> • The type of meat in each container • The age of the meat in each container • The amount of meat in each container • The size of the containers • The location in which the containers were kept • The temperature at which the containers were kept • The time(s) at which the containers were observed for maggots <p>d) (i) No – while this can be inferred from Redi’s experiment, there was a lack of direct observations to prove this inference. (ii) No – rotting meat failed to ‘generate’ maggots in the sealed and covered conditions, suggesting rotting meat alone is insufficient to cause maggots to form.</p> <p>e) (i) Type and state of organisms placed in containers (live flies, dead flies and dead maggots). (ii) The formation of maggots on meat occurs due to its exposure to live flies.</p>
12.3	2	<p>a) Microbes (yeast)</p> <p>b) Smaller microbes (bacteria)</p> <p>c) Heating it to between 60-100°C to kill microbes, then allowing it to cool.</p> <p>d) Pasteurisation</p> <p>e) Beer and milk</p> <p>f) Through his examination of wine ‘disease’, Pasteur uncovered that microbes were responsible for wine becoming sour. He then developed methods to prevent wine spoilage through killing microbes with heat. This helped Pasteur and others to infer that microbes caused disease in humans and that germ theory was correct.</p>

Chapter 12 [continued]

Section	Activity	Sample answers										
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	4	<ul style="list-style-type: none"> diseased • maggots • caused • Science • evidence • generation • prize spontaneous • microbes • cotton • appear • growing 										

Chapter 12 [continued]

Section	Activity	Sample answers
12.3	5	<p>a) To kill any existing microbes.</p> <p>b) He left it intact.</p> <p>c) He broke it off.</p> <p>d) Condition 2</p> <p>e) IV – shape of neck on flask (i.e. curved ‘swan’ shaped versus straight) DV – presence of microbial growth in the broth CV – • type of broth • length of time boiled • method of boiling • time(s) at which broth is observed for microbial growth • flasks being left at a constant environmental temperature</p> <p>f) Air particles constantly move, so can enter the flask. Dust and other particles (e.g. microbes) cannot move against gravity through upwards part of the neck.</p> <p>g) The broth would have become cloudy due to microbial growth.</p> <p>h) Microbes only developed in the flask open to the air, thus refuting the idea of spontaneous generation. This helped people to realise that microbes did not spontaneously generate in sick people, but were carried in the air, or by other means, as suggested by the germ theory.</p> <p>i) If the broth is only boiled briefly, pre-existing microbes in the broth may not be all killed. This could lead to microbial growth in both flasks.</p>
	6	<p>b) <i>Possible causes you may have given include:</i></p> <ul style="list-style-type: none"> • The broth was not boiled for long enough. • The equipment was not sterile at the start of the experiment. • The glassware was damaged or had a chip that allowed microbes to enter. • The swan-neck flask has been shaken or turned upside down.
12.4	2	<p>a) Koch is known as the ‘father of bacteriology’. He developed new equipment and techniques that allowed bacteria to be studied. Many of these are still the basis of bacteriology today.</p> <p>b) He identified that specific types of bacteria caused several diseases, and showed that transferring these bacteria into a healthy animal caused the disease. This helped to establish that specific microbes cause a disease.</p> <p>c) Specific conditions developed by Koch that could be used to determine the specific pathogen that causes a disease.</p>
	4	<p>a) 4</p> <p>b) In all diseased organisms.</p> <p>c) No</p> <p>d) In a pure culture.</p> <p>e) The same disease.</p> <p>f) The same microbe.</p> <p>g) Infectious</p>

Chapter 13

Section	Activity	Sample answers
12.4	5	<p>Koch's postulates could be used for some other pathogens (e.g. some fungi), but not for all pathogens. Koch's postulates require the causative agent to be able to be isolated and grown in pure culture. This is difficult for some microbes, e.g. viruses and prions. Koch's postulates also do not allow for pathogens with complex lifecycles that may not re-infect after being cultured.</p> <p>[Note: Koch's postulates also do not account for asymptomatic hosts, nor for varied disease presentation in different hosts.]</p>
12.6	1	<p>a) No</p> <p>b) No</p> <p>c) (1) In chicken eggs containing a live embryo; (2) in living cell cultures.</p> <p>d) Living cells taken from an organism and sustained as a living tissue culture.</p> <p>e) No</p> <p>f) Yes</p>
13.1	1	<p><i>Weak points where pathogens can enter the human body include:</i></p> <ul style="list-style-type: none"> • eyes • ears • nostrils • mouth (as an entry to the gastrointestinal tract and the respiratory tract) • urinary tract (the urethra) • anus • vagina (in women) • milk ducts of the nipples (in women) • any cuts or damaged skin regions • any insect bites in the skin
	2	<p>a) They produce special protein markers on their surfaces that identify them as 'self' cells.</p> <p>b) Any particle that triggers the immune system to respond.</p> <p>c) Yes – they are triggering the immune system to respond and so are acting as antigens in these individuals.</p>
	3	<p>a) B (barrier to entry)</p> <p>b) A (adaptive immune response)</p> <p>c) I (innate immune response)</p> <p>d) A (adaptive immune response)</p> <p>e) B (barrier to entry)</p> <p>f) I (innate immune response)</p> <p>g) A (adaptive immune response)</p> <p>h) B (barrier to entry)</p>

Chapter 13 [continued]

Section	Activity	Sample answers														
13.2	1	<ul style="list-style-type: none"> • entry • pathogens • body • through • digestive • entering • external • internal • respiratory • stomach 														
	2	<p>1:3, 2:1, 3:2, 4:4, 5:7, 6:5, 7:6</p> <p><i>i.e. the definitions from top to bottom are:</i></p> <ul style="list-style-type: none"> • mucous membranes • cilia • skin • pH • normal microflora • other fluid secretions • tears 														
	3	<p>a) <i>Physical:</i> Eyelids can close, eyebrows divert moisture and eyelashes help to keep airborne debris (and pathogens) out of the eye. <i>Chemical:</i> Tears flush out debris (and pathogens) and contain lysozyme, a chemical that helps to kill microbes.</p> <p>b) Respiratory tract, digestive tract, urinary tract, and vagina.</p> <p>c) Mucous membranes produce mucus, which traps microbes and other particles. Cilia help move mucus and any pathogens trapped in it out of the respiratory tract to prevent infection.</p> <p>d) Mucus goes to the stomach. Stomach acid will kill many pathogens in it.</p> <p>e) <i>Physical:</i> It provides an external barrier, blocking entry of microbes into the body. <i>Chemical:</i> Its acidity prevents the growth of many microbes.</p> <p>f) Lysozyme is able to break down bacterial cell walls, helping to kill the bacteria.</p> <p>g) The normal, harmless microflora inhibit pathogens from multiplying by competing for habitat and nutrients.</p> <p>h) During urination, muscle contractions and gravity help force urine down the urethra. The flow of urine flushes out pathogens from the urethra. Also, pathogens have trouble moving against this flow.</p>														
13.3	2	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">a) False</td> <td style="width: 50%;">h) False</td> </tr> <tr> <td>b) True</td> <td>i) True</td> </tr> <tr> <td>c) False</td> <td>j) True</td> </tr> <tr> <td>d) True</td> <td>k) True</td> </tr> <tr> <td>e) True</td> <td>l) False</td> </tr> <tr> <td>f) False</td> <td>m) True</td> </tr> <tr> <td>g) True</td> <td></td> </tr> </table>	a) False	h) False	b) True	i) True	c) False	j) True	d) True	k) True	e) True	l) False	f) False	m) True	g) True	
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Chapter 13 [continued]

Section	Activity	Sample answers
13.3	3	<p>a) Neutrophils and macrophages.</p> <p>b) Chemicals and enzymes from within the lysosome.</p> <p>c) Pacman can engulf yellow dots, which is similar to phagocytes engulfing antigens. Both are mobile.</p> <p>d) APCs can form from phagocytes, which are part of the innate immune response. They help to trigger specific attack on the antigen from T cells, which are formed by the adaptive immune response.</p> <p>e) Endocytosis is used to engulf antigen into a phagocyte, while exocytosis is used to remove remaining debris from the antigen out of the cell.</p> <p>[Note: Exocytosis is also used to place fragments of antigen on the cell surface to become an antigen-presenting cell.]</p>
	5	<p>a) Histamines and prostaglandins</p> <p>b) (1) Increased blood flow to an injured area. (2) Nearby blood capillaries dilate and become more permeable.</p> <p>c) It allows blood components (e.g. phagocytes) to respond to pathogens by entering tissues to help clear cellular debris and any microbes present.</p>
	6	<pre> graph TD A[Injury to body tissue] --> B[Release of chemicals (e.g. histamines and prostaglandins)] B --> C[Inflammatory response triggered] C --> D[Increased blood flow to injured tissue, nearby capillaries dilate and become more permeable.] D --> E[Blood components, e.g. phagocytes, exit capillary and enter tissue. This causes side effects, e.g. pain, swelling, redness and heat.] </pre>
7	<p>1. D</p> <p>2. C</p> <p>3. B</p> <p>4. A</p> <p>5. B</p> <p>6. C</p>	

Chapter 13 [continued]

Section	Activity	Sample answers
13.4	1	<ul style="list-style-type: none"> a) Leukocytes b) B and T cells c) In the bone marrow. d) B cells in the bone marrow, T cells in the thymus. e) Being able to bind a specific antigen. f) Many clones of it are formed. g) After primary exposure to a specific antigen. h) Memory B and T cells. i) No
13.4	2	<ul style="list-style-type: none"> a) Primary exposure allows memory B and T cells to form. These act like a database for how to respond to specific antigens, allowing a rapid response on re-exposure to the same antigen. b) The dose is so small that immunity occurs rather than the actual disease and so the individual develops memory B and T cells that will be activated on re-exposure to the same pathogen.
13.5	1	<ul style="list-style-type: none"> a) Innate and acquired (or adaptive). b) They have adaptive immunity. c) To keep things out of you (and to keep your organs inside you). d) Inflammation e) In the blood vessels. They can also migrate (ooze) out of capillaries into tissues. f) Pus g) Yes h) No i) They kill it. j) Antibody-generator k) Antibodies are proteins produced by B cells in response to specific antigens. <p>[Note: An antibody can bind to a specific antigen, to help stop intruders from harming the body.]</p> <p><i>[continues next page]</i></p>

Chapter 13 [continued]

Section	Activity	Sample answers															
13.5	1	<p>l)</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th colspan="2" style="text-align: center;"><i>Type of lymphocyte</i></th> </tr> <tr> <th></th> <th style="text-align: center;"><i>B cell</i></th> <th style="text-align: center;"><i>T cell</i></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><i>Where it develops</i></td> <td style="text-align: center;">Bone marrow</td> <td style="text-align: center;">Bone marrow</td> </tr> <tr> <td style="text-align: center;"><i>Where it matures</i></td> <td style="text-align: center;">Bone marrow</td> <td style="text-align: center;">Thymus gland</td> </tr> <tr> <td style="text-align: center;"><i>Type of response</i></td> <td style="text-align: center;">Humoral response</td> <td style="text-align: center;">Cell-mediated response</td> </tr> </tbody> </table> <p>m) 1:2, 2:4, 3:1, 4:3 <i>i.e. the definitions from top to bottom are:</i></p> <ul style="list-style-type: none"> • Memory T or B cells • Helper T cells • Plasma B cells • Cytotoxic T cells 		<i>Type of lymphocyte</i>			<i>B cell</i>	<i>T cell</i>	<i>Where it develops</i>	Bone marrow	Bone marrow	<i>Where it matures</i>	Bone marrow	Thymus gland	<i>Type of response</i>	Humoral response	Cell-mediated response
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13.6	1	<ul style="list-style-type: none"> • Plasma B cells <i>Role:</i> They produce antibodies that are specific to the antigen that activated the B cell. • Memory B cells <i>Role:</i> To remain in the body and provide immunity on re-exposure to the same antigen. 															
	2	<p>a) Plasma B cells b) The ribosomes c) No d) No e) Antigen binding sites on antibodies have a specific shape or structure, which needs to match the shape or structure of the antigen. f) They help to flag the antigen as needing to be dealt with by other parts of the immune system (e.g. phagocytes).</p> <p>[Note: They also prevent some antigens (e.g. bacterial toxins) from invading cells.]</p>															
	3	<p>a) The concentration of antibodies produced in the primary response is significantly lower than in the secondary response. b) The time taken for a peak in antibody concentration after exposure is far longer in the primary response compared to the secondary response. c) Memory B and T cells are formed following a primary exposure to an antigen. These memory B and T cells recognise an antigen on re-exposure, thus allowing a more rapid and stronger response.</p>															

Chapter 13 [continued]

Section	Activity	Sample answers
13.6	4	<p>a) It is the only B-cell with a receptor that matches the specific antigen and so can bind to it.</p> <p>b) Plasma B cells and memory B cells.</p> <p>c) Plasma B cells.</p> <p>d) Re-exposure to the same antigen.</p> <p>e) Re-exposure.</p>
13.7	1	<ul style="list-style-type: none"> • Cytotoxic T cells <i>Role:</i> Recognise body cells infected with an intracellular pathogen and release chemicals to kill the cell. • Helper T cells <i>Role:</i> Release chemicals to stimulate other immune cells. • Memory T cells <i>Role:</i> Allow a more effective response if re-exposure occurs. • Suppressor T cells <i>Role:</i> Inhibit immune cells at the end of an immune response.
	2	Plasma B cells can only respond to extracellular antigens and so cannot respond to intracellular viruses. Whereas cytotoxic T cells can recognise and kill cells that have been invaded by viruses.
13.7	3	<p>a) An antigen-presenting cell</p> <p>b) Phagocytes</p> <p>c) Cytokines</p> <p>d) No</p> <p>e) Activate B and cytotoxic T cells</p>
	4	<p>a) A pathogen [OR you could specify a type of pathogen, e.g. virus.]</p> <p>b) Perforins create pores in the cell membrane.</p> <p>c) Break down internal proteins.</p> <p>d) Damage from perforins and granzymes</p> <p>e) Helper T cells produce cytokines that are needed to activate cytotoxic T cells.</p>

Chapter 13 [continued]

Section	Activity	Sample answers
13.8	1	<ul style="list-style-type: none"> a) The skin b) The inflammatory response has occurred – with increased blood flow and white blood cells entering the tissue. c) Engulf and destroy these antigens. Some will display processed antigen on their exterior, becoming antigen-presenting cells. d) They will temporarily bind to each other and both will release cytokines. This will activate the helper T cells. e) It will proliferate (make copies of itself). Most copies will be antibody producing plasma B cells, some copies will be memory B cells. f) Cytotoxic T cells eliminate infected cells. These bacteria cannot enter cells, so there will be no infected cells in this case. g) Phagocytes h) Suppressor T cells i) Memory B and T cells
	2	<ul style="list-style-type: none"> a) Direct b) Mucous membranes, mucus and cilia. c) Infected neighbouring cells will have apoptosis stimulated. Uninfected neighbouring cells will destroy RNA and reduce protein synthesis to help prevent infection. d) They will use chemicals to induce apoptosis (cell suicide). e) Memory B cells and memory T cells f) Plasma B cells g) Induce apoptosis (cell death). h) Helper T cells i) No. He will have immunity from his prior exposure and mount an effective secondary response.

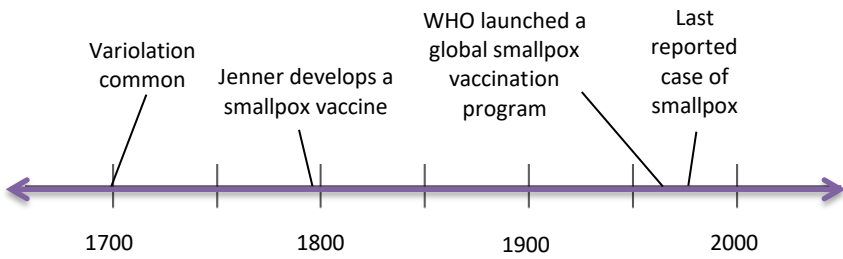
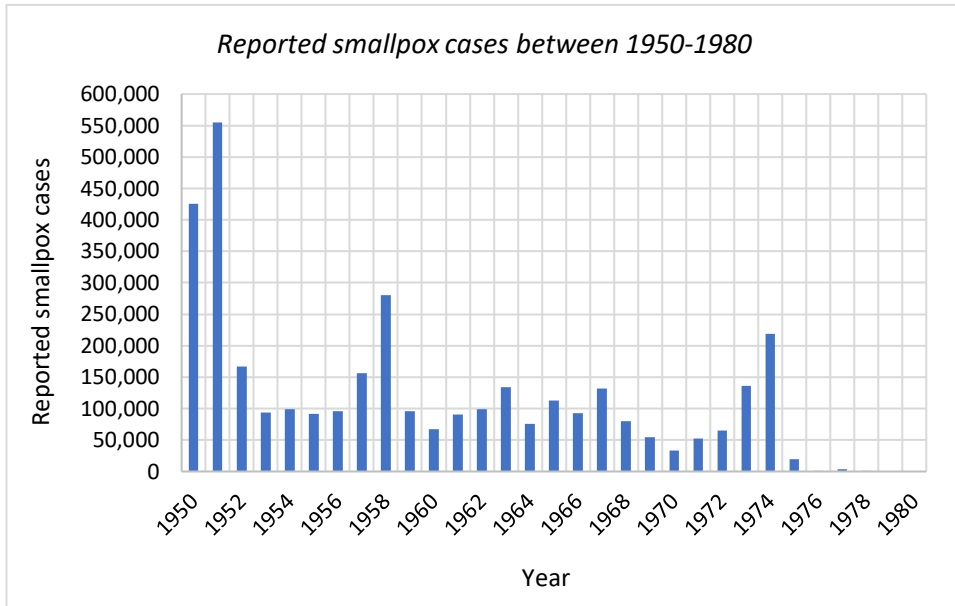
Chapter 13 [continued]

Section	Activity	Sample answers				
13.9	1	<p>a) <i>Many possible answers</i> – including any named mammal, bird, reptile, amphibian or fish.</p> <p>b) The complexity of immune responses is unlikely to have developed by chance via convergent evolution. It suggests vertebrates have diverged from a common ancestor.</p> <p>c)</p> <table border="1"> <thead> <tr> <th><i>Innate immune response</i></th> <th><i>Acquired immune response</i></th> </tr> </thead> <tbody> <tr> <td> <ul style="list-style-type: none"> • Inflammatory chemicals, e.g. histamines and prostaglandins • Antimicrobial proteins being secreted • Redness, swelling and heat </td> <td> <ul style="list-style-type: none"> • Antibodies in body fluids • Swelling in glands (due to increased cell division) </td> </tr> </tbody> </table>	<i>Innate immune response</i>	<i>Acquired immune response</i>	<ul style="list-style-type: none"> • Inflammatory chemicals, e.g. histamines and prostaglandins • Antimicrobial proteins being secreted • Redness, swelling and heat 	<ul style="list-style-type: none"> • Antibodies in body fluids • Swelling in glands (due to increased cell division)
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2	<p>a) <i>Many possible answers, e.g.</i> any insect, worm or crustacean</p> <p>b) Innate – it is not pathogen specific and does not improve over time.</p>					

Chapter 14

Section	Activity	Sample answers
14.1	1	<ul style="list-style-type: none"> • resist • artificially • specific • exposure • vaccination • antibodies • produce • naturally • milk • bite • antivenom
	2	<p>a) 1. Prior exposure to a disease. 2. Antibodies in breast milk to a baby (or across the placenta to a foetus)</p> <p>b) 1. Vaccinations. 2. Injections of antibodies.</p> <p>c) Both help an individual resist disease. In passive immunity, another individual has produced the antibodies, while in active immunity, the individual has specific memory cells and produces their own antibodies.</p>
	3	<p>a) No. The memory B and T cells that develop from a chicken pox vaccine would not provide immunity for measles, as it is a different antigen.</p> <p>b) This will produce antibodies in the mother that will pass to the newborn via breast milk, giving the newborn passive immunity to whooping cough.</p>
	4	<p>a) They are killed first or given as a non-virulent (weakened) strain.</p> <p>b) <i>Many possible answers, e.g. tetanus or whooping cough.</i></p> <p>c) After initial vaccination, a time delay occurs before antibodies are produced. The antibody level rises to a peak, then decreases to below the concentration required for immunity. A booster vaccination quickly increases the antibody level, and the remaining antibody level after a decline is sufficient to provide immunity.</p> <p>d) To ensure that the level of antibodies remaining in the blood is high enough to provide immunity.</p> <p>e) The memory B and T cells formed after an initial vaccination quickly recognise an antigen on re-exposure to it in a booster vaccine and so rapidly produce a large number of antibodies.</p>
	5	<p>a) DPT (diphtheria, pertussis, tetanus), human papillomavirus (2 doses), meningococcal ACWY</p> <p>b) <ul style="list-style-type: none"> • influenza (annually) • shingles (if chickenpox was not had as a child) • pertussis [whooping cough] (if pregnant) • pneumococcal (if over 65 years) • zoster (if over 70 years) • travel vaccines as recommended for destination countries <p>[Note: Many doctors also recommend getting a tetanus booster every 10 years – this is given as a DPT vaccine (diphtheria, pertussis, tetanus).]</p> </p> <p>c) <ul style="list-style-type: none"> • adults over 65 years • Aboriginal Australians: 15-49 years with medical risk factors, 50 years and over </p>

Chapter 14 [continued]

Section	Activity	Sample answers
14.1	6	<p>a) While the puppy is receiving milk from its mother, it is receiving maternal antibodies. Once the puppy leaves its mother, maternal antibodies will naturally decline over time.</p> <p>b) Its antibodies are zero at birth, as any disease exposure is taken care of by the mother's antibodies. Each scheduled vaccination results in a stronger response each time, thus increasing the number of antibodies, and memory B and T cells against the causative pathogen.</p> <p>c) The maternal antibodies interfere with the vaccine's ability to cause memory B and T cells to form in the puppy.</p> <p>d) The maternal antibodies are below the level required for immunity, and the puppy's antibodies have not yet reached the level required for immunity. Hence the puppy is not immune during the green period.</p> <p>e) <i>Top right corner of the green box.</i></p>
14.2	1	<p>People were scared of dying from smallpox, which was very common at this time. The risks of variolation were perceived as being lower than the risk of naturally getting smallpox and dying.</p>
	2	<p>An example of a suitable timeline is provided below:</p> 
	3	<p><i>Reported smallpox cases between 1950-1980</i></p> 

Chapter 14 [continued]

Section	Activity	Sample answers
14.3	1	<p><i>You should have made your own dot-point notes for this activity.</i></p> <p><i>Below are some of the key points from the video:</i></p> <ul style="list-style-type: none"> The chemicals (e.g. mercury and aluminium) in vaccines are at such a low dose they are not considered to be harmful. There is no scientific evidence that these chemicals cause harm in vaccines. [Note: Mercury-containing compounds have been removed from most vaccines since 2001 to ease public concern, although these compounds are still not considered harmful.] Large studies show vaccines reduce and help protect against allergies. Vaccines tackle diseases that can cause death and severe disabilities, e.g. smallpox, polio and rubella. A 1990s paper suggested a link between the MMR vaccine and autism. However, 25 international papers have refuted the claims of this single paper and many of the authors of the original paper have subsequently refuted their own paper. Vaccines are not just about the individual, but rather they protect you and those around you, due to herd immunity. Vaccines are highly regulated and have many phases of testing to ensure they are safe, effective and at the correct dose. This sometimes takes up to 25 years to get approval. The odds of having a severe reaction to the MMR vaccine is 1 in 1 million. This is 10x less likely than being killed by a lightning bolt.
	2	<p>a) 95%</p> <p>b) The elderly, babies (and the immunocompromised).</p> <p>c) <i>Multiple correct answers</i> – ensure that you indicate whether you agree or not AND that you justify your opinion.</p>
	3	<p>a) Vaccination rates are likely to increase, since the majority of unvaccinated children have parents who do not object to vaccination.</p> <p>b) A high percentage of people being vaccinated provides herd immunity as there are less susceptible people to become infected. So it is difficult for a disease to spread. This helps to protect more vulnerable people (e.g. babies, elderly and immunocompromised).</p> <p>c) Such children may have a weaker immune system, so vaccinating the other children helps to prevent diseases being transmitted to them.</p>

Chapter 14 [continued]

Section	Activity	Sample answers														
14.3	4	<p>Some key components of 'Save the date to vaccinate' that you may have included in your answer are:</p> <ul style="list-style-type: none"> • A mobile app (or printable personal schedule) is available to keep track of vaccination due dates and vaccine records. • It is important to vaccinate on time and to keep a record. • Having vaccines is important, the benefits outweigh the risks. • Where to go for a vaccine, e.g. who provides vaccinations. <p>Your answer should also make a prediction, e.g.</p> <p>This initiative will improve vaccination rates by assisting parents in being aware and organised for getting scheduled vaccinations for their child.</p>														
14.4	1	<table> <tbody> <tr> <td>a) Entry</td> <td>h) Transmission</td> </tr> <tr> <td>b) Entry</td> <td>i) Entry</td> </tr> <tr> <td>c) Transmission</td> <td>j) Transmission</td> </tr> <tr> <td>d) Transmission</td> <td>k) Transmission</td> </tr> <tr> <td>e) Transmission</td> <td>l) Transmission</td> </tr> <tr> <td>f) Transmission</td> <td>m) Entry</td> </tr> <tr> <td>g) Entry</td> <td>n) Transmission</td> </tr> </tbody> </table>	a) Entry	h) Transmission	b) Entry	i) Entry	c) Transmission	j) Transmission	d) Transmission	k) Transmission	e) Transmission	l) Transmission	f) Transmission	m) Entry	g) Entry	n) Transmission
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Chapter 14 [continued]

<i>Section</i>	<i>Activity</i>	<i>Sample answers</i>
14.4	3	<p>a) Over a year's time, the influenza virus will have mutated to the extent that it has new subtypes with new antigenic properties. This means that immunity provided by prior flu vaccines will not be effective.</p> <p>b) Viral envelopes made of host cell membranes will be less likely to be recognised as antigens, as they will have host proteins and seem less foreign than non-enveloped viruses.</p> <p>c) It allows the spread of antibiotic resistance genes to existing bacteria (not just the offspring of the bacterium with the initial resistance mutation). This will enable more bacteria to be able to survive antibiotic treatments.</p> <p>d) These two proteins increase the ability of the virus to enter human cells. Here the virus can reproduce and make many more copies of the virus and so cause the disease.</p>

Chapter 15

Section	Activity	Sample answers
15.1	1	<p>a) High (or you could argue medium due to antibiotic resistance)</p> <p>b) Unsuitable</p> <p>c) Low</p> <p>d) Low</p> <p>e) Unsuitable</p>
	2	<p>* <i>Note: There are multiple correct answers for these questions. The answers provided use the information available in Activity 15.1.</i></p> <p>a) <i>Any three of the following:*</i> Penicillins, vancomycin, gentamicin, tetracyclines</p> <p>b) <i>Multiple correct answers, including:*</i></p> <ul style="list-style-type: none"> • Vancomycin disrupts cell wall synthesis. • Gentamicin disrupts bacterial protein synthesis. • Tetracyclines disrupt bacterial protein synthesis. <p>c) Penicillium fungi.</p>
	3	<p>a) The antibiotic will be stronger, and so more effective. Side effects from other substances present in a natural mixture will not occur.</p> <p>b) Bacterial cells are prokaryotic with a cell wall, while human cells are eukaryotic, much larger in size and do not have a cell wall.</p>
	4	<p>a)</p> <p>[Note: The labels for 'clear zone', 'bacterial growth' and 'antibiotic disc' could have been placed in numerous correct locations.]</p>

Chapter 15 [continued]

Section	Activity	Sample answers								
15.1	4	<p>b) <i>Multiple correct answers, e.g.</i></p> <table border="1"> <thead> <tr> <th>Safety risk</th> <th>Safety measures to reduce level of risk</th> </tr> </thead> <tbody> <tr> <td>Exposure to pathogenic bacteria grown on the plate.</td> <td>Sterilise benchtop and wash hands thoroughly after handling plate.</td> </tr> <tr> <td>Harm to skin microflora due to over-exposure to antibiotics.</td> <td>Do not handle antibiotic discs – wear gloves or use tools, e.g. tweezers, to handle the antibiotic discs.</td> </tr> <tr> <td>Exposure to pathogenic bacteria when handling patient sample(s).</td> <td>Wear gloves and use sterile techniques. Dispose of patient sample(s) in a special biohazard bin.</td> </tr> </tbody> </table>	Safety risk	Safety measures to reduce level of risk	Exposure to pathogenic bacteria grown on the plate.	Sterilise benchtop and wash hands thoroughly after handling plate.	Harm to skin microflora due to over-exposure to antibiotics.	Do not handle antibiotic discs – wear gloves or use tools, e.g. tweezers, to handle the antibiotic discs.	Exposure to pathogenic bacteria when handling patient sample(s).	Wear gloves and use sterile techniques. Dispose of patient sample(s) in a special biohazard bin.
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5	<p>a) Random mutations can lead to new variations in bacteria, e.g. antibiotic resistance. Widespread use of antibiotics creates a strong selection pressure for antibiotic resistance, favouring the survival of resistant bacteria. This leads to widespread resistance in the bacterial population.</p> <p>b) Antibiotics are mainly used to treat bacterial infections and cannot be used to treat viral infections. The doctor did not prescribe antibiotics as they would not help to treat Natalie’s illness if it is caused by a virus.</p> <p>c) The pathology results would have indicated the causative bacterium and indicated which antibiotic would treat it more specifically and effectively. This more specific antibiotic would have less impact on his microflora.</p> <p>d) Specific antibiotics are used to treat specific conditions. Her previous antibiotics may not be at all suited to the bacteria infecting her wounds.</p> <p>[Note: Another possible answer could refer to the role of excessive use of antibiotics in the development of antibiotic-resistant bacteria.]</p>									
15.2	1	<p>a) Intracellular pathogens are ‘hidden’ inside host cells and so are difficult for drugs to access or target without harming the host cells.</p> <p>b) Killing the pathogen is likely to damage the host cells and/or interfere with host cell function, leading to side effects.</p> <p>c) They are likely to have negative side effects for the host that outweigh their benefits when treating mild conditions.</p>								
	2	<p>Only certain viruses are slow to progress to being symptomatic, thus leaving time for treatment by a suitable vaccine. The vaccine delivers a safe form of the infecting virus. This brings about an immune response in the infected person and the formation of specific B and T cells to respond to the infection.</p>								

Chapter 15 [continued]

<i>Section</i>	<i>Activity</i>	<i>Sample answers</i>							
15.2	3	<p>a) No.</p> <p>b) Management of symptoms.</p> <p>c) Influenza and HIV.</p> <p>d) It inhibits the enzyme that the replicated influenza virus needs to exit infected cells.</p> <p>e) If an advantageous mutation arises in HIV that provides resistance to one treatment drug, one of the other treatment drugs might still be able to kill this virus or prevent it from reproducing. It is unlikely that any individual viruses will mutate enough to be resistant to all of the drugs.</p>							
	4	Interferon is an antimicrobial protein produced as part of the innate immune response to some viruses. It aids this response by signalling uninfected cells to destroy RNA (thus reducing protein synthesis) and signalling infected cells to undergo apoptosis (cell suicide). It also helps activate other immune cells.							
15.3	1	In spite of increased antibiotic resistance, there are still many different antibiotics that are available to effectively treat diseases caused by bacteria. In contrast, there are very few antivirals available and they can only be used against a few specific viruses. So, antibiotics are generally more available and effective relative to antivirals.							
	2	<p>a)</p> <table border="1" data-bbox="523 1205 1394 1720"> <tbody> <tr> <td><i>Type of pathogen</i></td> <td>Virus (Hepatitis C virus)</td> </tr> <tr> <td><i>Methods of transmission</i></td> <td>Directly by blood-to-blood contact or indirectly by contact with blood contaminated fomites.</td> </tr> <tr> <td><i>Symptoms</i></td> <td>Initially: dark urine, flu-like symptoms, and jaundice (yellowing of the skin). In chronic infections: nausea, fever, pain, skin rash, scarring of the liver (cirrhosis). [Note: Some cases are asymptomatic.]</td> </tr> <tr> <td><i>Disease prevention</i></td> <td>Use protective measures if coming into contact with another person's blood (e.g. gloves when dressing wounds) and ensure equipment used on your body is sterile (e.g. needles, razors, etc).</td> </tr> </tbody> </table> <p>b) Several drugs, known as direct-acting antivirals (DAAs), are given as oral tablets in combination to treat hepatitis C. These drugs have few side effects and can treat most hepatitis C patients within a few months. Different drug combinations are used depending on the virus strain.</p>	<i>Type of pathogen</i>	Virus (Hepatitis C virus)	<i>Methods of transmission</i>	Directly by blood-to-blood contact or indirectly by contact with blood contaminated fomites.	<i>Symptoms</i>	Initially: dark urine, flu-like symptoms, and jaundice (yellowing of the skin). In chronic infections: nausea, fever, pain, skin rash, scarring of the liver (cirrhosis). [Note: Some cases are asymptomatic.]	<i>Disease prevention</i>
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Chapter 15 [continued]

15.3	3	<p>a) Bacteria-eater</p> <p>b) Bacteria</p> <p>c) No</p> <p>d) Antibiotics were developed and successful as a treatment. Most bacteriophage research occurred in the Soviet Union and was kept secret.</p> <p>e) Reduced antibiotic efficacy due to antibiotic resistance.</p>
	4	<p>A phage attaches to a host bacterial cell and inserts its DNA. The phage DNA uses the host cell to replicate its DNA and produce phage proteins. This allows more phages to be made. The phages then burst out of the host cell, killing the bacterium.</p>
15.4	1	<p>a) Hygiene, such as washing hands, reduces pathogen transmission between people, while avoiding eating certain meats that are often contaminated with pathogens reduces pathogen entry into the body.</p> <p>b) Separating lepers was a form of quarantine. Their separation helped to prevent transmission of the pathogenic bacteria that caused leprosy by reducing both direct contact and indirect contact with susceptible hosts.</p>
	2	<p><i>Prediction: Harmful</i></p> <p><i>Examples of some possible reasons for this prediction:</i></p> <ul style="list-style-type: none"> • Blood is essential for transporting nutrients around the body and removing wastes. Removing blood will reduce the efficacy of transport within the body and so cause harm. • Blood contains white blood cells, which are an important part of the natural immune response to combat pathogens. Removing blood will reduce the amount of white blood cells present and so hinder the ability of the body to respond to infectious diseases. • Bloodletting was probably done using unsterile equipment and so may have further spread disease. • Bloodletting exposed other people to blood that may have been contaminated with pathogens, aiding the spread of disease.
	3	<p><i>Multiple possible answers, including:</i></p> <ul style="list-style-type: none"> • It threatens to cause the extinction of tigers as a species, reducing their biodiversity. • Individuals who believe remedies using tiger parts will cure them may not seek appropriate medical treatment(s) for their condition. • Black market trade is difficult for society to regulate and can often lead to exorbitant prices for goods with no quality-guarantee.

Chapter 15 [continued]

Section	Activity	Sample answers
15.4	4	<p>a) Pain is a common symptom of many different infectious diseases. Painkillers would have reduced the physical suffering of many people infected with a disease, including those dying from such a disease.</p> <p>b) Effective painkillers tend to act in a relatively short space of time and alter perceptions of reality (including pain). This led to ancient cultures more readily being able to observe and infer the effects of specific painkillers relative to other remedies they had for diseases.</p>
	5	<p>a) Traditional knowledge provided the initial observations and the inspiration for research into analgesics extracted from <i>B. acutangula</i>.</p> <p>b) Traditional knowledge can probably provide oral records of side effects observed when using <i>B. acutangula</i> as a traditional painkiller.</p> <p>c) Indigenous people collectively have a wealth of knowledge that has been developed over many years of observation. Their intellectual property deserves recognition and appropriate remuneration to encourage collaboration in scientific investigations and fairness for all involved.</p> <p>d) It takes many years of testing to demonstrate that a drug is safe, to determine what dose needs to be taken for maximum effectiveness, and to ensure that all of its side effects are known.</p>
	6	<p>a) The efficacy and side effects of many bush medicines are not fully known. Scientific research can assist in determining these.</p> <p>b) No – language and distance barriers would have led to many tribes having unique knowledge and using natural resources in their local area.</p> <p>c) Different Indigenous communities will each have unique knowledge of plants and traditional medicines that has developed over many years via observation and inference that may help to inspire and guide research.</p>

Chapter 16

Section	Activity	Sample answers
16.1	2	1:3, 2:5, 3:1, 4:4, 5:2, 6:6 <i>i.e. the definitions from top to bottom are:</i> • outbreak • disease incidence • endemic level of disease • pandemic • epidemic • disease prevalence
	3	a) Outbreak / epidemic b) Outbreak / epidemic c) Endemic disease d) Pandemic e) Endemic disease f) Outbreak / epidemic
	4	They increase the risk of infectious diseases being transmitted. Pathogens can be transported globally and quickly enough that they are still viable and so can be transmitted to people in other regions.
	5	Quarantine limits the ability of pathogens in one individual to spread to other susceptible hosts. Quarantine significantly reduces the likelihood of transmission via direct contact, and also aids in reducing the risk of other forms of transmission, such as vector or indirect transmission. Once the individual has recovered via their immune system and/or treatment, they can cease to be isolated and are safe to mingle with others.
16.2	1	• virus • vector • mosquito • endemic • symptoms • limiting • response • week • severe • deadly • cure • preventative • repellent • clothing
	2	a) The dengue virus b) Mosquitoes (e.g. <i>Aedes aegypti</i>) c) Serious flu-like symptoms d) One week e) No f) By avoiding mosquitoes bites, e.g. by using insect repellent, insect nets and wearing protective clothing.
	3	Current preventative measures focus on avoiding mosquito bites, e.g. by using insect nets and insect repellent. These are moderately effective. A dengue vaccine would be more effective, as it would allow memory B and T cells to form in individuals that can prevent symptoms when they are exposed to the dengue virus.

Chapter 16 [continued]

Section	Activity	Sample answers
16.2	4	<p>a) 0</p> <p>b) <i>Multiple correct answers, e.g. India and Brazil</i></p> <p>c) Population sizes vary significantly between different countries. Using data on deaths per million persons allows comparison between countries without population size acting as a confounding variable.</p> <p>d) Tropical climate causes an increase in the incidence of dengue fever, whereas cooler, drier regions have lower dengue fever incidence.</p> <p>e) The mosquitoes that cause dengue fever have an optimal habitat climate. Climate changes that make Australia warmer will provide suitable habitat for these mosquitoes and so dengue fever could reach Australia.</p>
	5	<p>a) Lethality gene and fluorescent gene.</p> <p>b) Using tetracycline antibiotic.</p> <p>c) To show which mosquitoes have successfully had the lethality gene incorporated into their genome.</p> <p>d) They no longer have access to tetracycline.</p> <p>e) Size</p> <p>f) Female</p> <p>g) Male</p> <p>h) The offspring inherit the lethal gene and will die.</p> <p>i) Very effectively – 95% reduction.</p>
	6	<p>Oxitec used GE to produce ‘friendly mosquitoes’. When these GE mosquitoes breed, their offspring inherit the lethal gene and so will die. This use of GE is very effective in reducing mosquito populations and so has reduced their spread of several infectious diseases.</p>

Chapter 16 [continued]

Section	Activity	Sample answers												
16.3	1	<table border="1"> <tr> <td><i>Type of pathogen</i></td> <td>Virus</td> </tr> <tr> <td><i>Method of transmission</i></td> <td>Droplet infection (direct or indirect contact). [Note: Measles is highly infectious.]</td> </tr> <tr> <td><i>Typical symptoms</i></td> <td>High fever, runny nose, cough, red watery eyes, Koplik spots (white spots inside the cheek), and a skin rash. [Note: Most of these symptoms typically occur after 10 days of incubation, followed by the rash a few days later.]</td> </tr> <tr> <td><i>Possible complications</i></td> <td>Ear infections, pneumonia, diarrhoea, inflammation of the brain ... and rarely, subacute sclerosing panencephalitis (SSPE) [persistent brain inflammation].</td> </tr> <tr> <td><i>Treatment</i></td> <td>No specific antivirals are available. Treatment focuses on support, including ensuring hydration, rest and nutrition. [Note: Vitamin A has been linked to a reduction in the risk of complications – especially in countries with vitamin A deficiency.]</td> </tr> <tr> <td><i>Disease prevention</i></td> <td>Vaccination – usually given as part of the measles, mumps, rubella (MMR) vaccine in childhood vaccination programs. [Note: Measles antibodies are sometimes given to those exposed to measles, but unable to have the vaccine (e.g. due to immunosuppression).]</td> </tr> </table>	<i>Type of pathogen</i>	Virus	<i>Method of transmission</i>	Droplet infection (direct or indirect contact). [Note: Measles is highly infectious.]	<i>Typical symptoms</i>	High fever, runny nose, cough, red watery eyes, Koplik spots (white spots inside the cheek), and a skin rash. [Note: Most of these symptoms typically occur after 10 days of incubation, followed by the rash a few days later.]	<i>Possible complications</i>	Ear infections, pneumonia, diarrhoea, inflammation of the brain ... and rarely, subacute sclerosing panencephalitis (SSPE) [persistent brain inflammation].	<i>Treatment</i>	No specific antivirals are available. Treatment focuses on support, including ensuring hydration, rest and nutrition. [Note: Vitamin A has been linked to a reduction in the risk of complications – especially in countries with vitamin A deficiency.]	<i>Disease prevention</i>	Vaccination – usually given as part of the measles, mumps, rubella (MMR) vaccine in childhood vaccination programs. [Note: Measles antibodies are sometimes given to those exposed to measles, but unable to have the vaccine (e.g. due to immunosuppression).]
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	2	<p>Infectious diseases cause a range of symptoms – some are simply unpleasant, others are more severe, e.g. measles causes cold-like symptoms and a rash, and can also cause inflammation of the brain. Vaccines effectively prevent many such infectious diseases. They involve very minor discomfort compared to the impact of having the disease. There is no treatment for many viruses, including measles. So, it is better to prevent the disease than try to cure it.</p>												

Chapter 16 [continued]

Section	Activity	Sample answers
16.3	3	<p>a) 124</p> <p>b) 340</p> <p>c) 81</p> <p>d) No – population has increased, but there is no corresponding steady increase over time in the number of measles cases.</p> <p>e) Measles is highly contagious. It is spread by droplet infection, which can involve direct or indirect contact. So it spreads to people in proximity to the original infected individual, forming a cluster of cases nearby.</p> <p>f) From international tourists to Australia who are infected with measles or from unvaccinated Australians who contract measles while travelling and return while infectious.</p> <p>g) Travellers may be asymptomatic when they arrive and come through the airport. They cannot be identified using any visible signs during the first 10 days of infection and so are unlikely to be quarantined.</p>
	4	<p>a) 25-29 years</p> <p>b) 5-9 years</p> <p>c) 4</p> <p>d) 2</p> <p>e) This figure will include children under 12 months of age, who are too young to have yet been vaccinated.</p> <p>f) Their children will not be fully vaccinated yet. So the risk of these children contracting measles in these countries is high.</p> <p>g) Most people receive the vaccine as a child and so have no memory of receiving the vaccine. They may not be in contact with their parents/guardians, or these people may too have forgotten.</p> <p>h) Vaccinating children and adults provides herd immunity. It eliminates having a reservoir of susceptible hosts for infectious diseases, such as measles. Thus it provides protection for more vulnerable members of our society, e.g. newborn babies and immunocompromised people.</p>
	5	<p>1. B</p> <p>2. D</p> <p>3. A</p> <p>4. D</p>
	6	<p>Australia's approach to measles features good prevention and control measures. Vaccination is used as an effective preventative measure, while public health units respond to any measles incidences to further reduce its spread. However, outbreaks still occur. There is a need for more Australians to have the vaccine for measles, as well as better approaches to identify international travellers that bring measles cases to the Australia.</p>

Chapter 17

Section	Activity	Sample answers												
17.1	1	<p>a) Microbes, e.g. fungi and bacteria, aphids, caterpillars and grasshoppers, as well as large herbivores.</p> <p>b) The lignin is tough to chew and impermeable to pathogens.</p> <p>c) <i>Any two of the following:</i></p> <ul style="list-style-type: none"> • Waxy cuticles on leaves. • Painful structures, such as horns/spines/prickles. • Trichomes on leaves (which are sharp and can release chemical irritants in some species). <p>d) In each individual plant cell.</p> <p>e) <i>Any two of the following:</i></p> <ul style="list-style-type: none"> • Thickening of the wax cuticle on leaves. • Thickening of the cell walls. • Guard cells seal the stomata (pores in the leaves). • Cell death to seal off pathogens. • Toxin production . <p>f) Using hormones, airborne compounds and electric signals.</p> <p>g) In response to caterpillars, they release specific chemicals into the air. This attracts parasitic wasps that lay their eggs in the caterpillars.</p>												
17.2	2	<table border="1"> <tbody> <tr> <td><i>Type of pathogen</i></td> <td>A water mould (<i>Phytophthora infestans</i>). [Note: You can use the word <i>fungus</i> instead of <i>mould</i>.]</td> </tr> <tr> <td><i>Method of transmission</i></td> <td> <ul style="list-style-type: none"> • Vehicle transmission of spores (e.g. soil contaminated with spores, or by wind dispersal). • Direct contact with spores on plant / tubers. • Indirect contact with fomites contaminated with spores. </td> </tr> <tr> <td><i>Typical symptoms</i></td> <td>Dark blotches on stems and leaves. Dark patches and rotting of potatoes.</td> </tr> <tr> <td><i>Treatment</i></td> <td>No treatment is available.</td> </tr> <tr> <td><i>Disease prevention</i></td> <td>Regular spraying of crops with fungicides.</td> </tr> <tr> <td><i>Disease control measures</i></td> <td> Destroy area where disease is found, as well as a surrounding area. Destroy any containers in which blight is found. </td> </tr> </tbody> </table>	<i>Type of pathogen</i>	A water mould (<i>Phytophthora infestans</i>). [Note: You can use the word <i>fungus</i> instead of <i>mould</i> .]	<i>Method of transmission</i>	<ul style="list-style-type: none"> • Vehicle transmission of spores (e.g. soil contaminated with spores, or by wind dispersal). • Direct contact with spores on plant / tubers. • Indirect contact with fomites contaminated with spores. 	<i>Typical symptoms</i>	Dark blotches on stems and leaves. Dark patches and rotting of potatoes.	<i>Treatment</i>	No treatment is available.	<i>Disease prevention</i>	Regular spraying of crops with fungicides.	<i>Disease control measures</i>	Destroy area where disease is found, as well as a surrounding area. Destroy any containers in which blight is found.
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	3	Genetic engineering is being worked on to create blight-resistant potato crops. Such crops (once perfected) would be resistant to late blight and so would not be able to be infected, reducing the spread of this disease.												

Chapter 17 [continued]

Section	Activity	Sample answers						
17.2	4	Agricultural crops are important as a food source for society and to make other products (e.g. fabrics). Diseases in agricultural crops cause affected plants to be less productive, e.g. late blight in potatoes causes potatoes to rot. Less productive crops harm farmers, reducing their profits and harm society, by reducing available food sources, e.g. late blight during the Great Famine caused many people to starve and left many farmers destitute.						
17.3	3	<p><i>Examples of questions you could inquire into for your research include:</i></p> <ul style="list-style-type: none"> • What type of pathogen causes the disease? • What types of plants can this disease occur in? • What are the symptoms of the disease? • How common is this disease in Australia? • What is an Australian native plant that this disease can occur in? • How do infected Australian native plants respond to this disease? • How can this disease be prevented and/or controlled? • Does this disease impact agricultural production? If so, how? 						
17.4	2	<p>a) All food (including herbs, infant formula, dried meats, etc), seeds, plants, parts of plants, any animal products, untreated wooden products, dirty hiking equipment e.g. muddy boots or a dirty tent.</p> <p>b)</p> <table border="1" style="margin-left: 20px;"> <tbody> <tr> <td>• <i>Farmers</i></td> <td>To protect their crops and/or livestock from disease, which in turn protects their source of income.</td> </tr> <tr> <td>• <i>Australia's economy</i></td> <td>To ensure agricultural production is profitable and that Australia's agricultural exports continue to be purchased internationally.</td> </tr> <tr> <td>• <i>Everyday Australians</i></td> <td>To provide locally grown food options that are safe to consume, readily available and reasonably priced.</td> </tr> </tbody> </table> <p>c) Foods and untreated wooden products can both provide habitats for pathogens. So, these objects can act as fomites, transmitting disease by indirect contact.</p>	• <i>Farmers</i>	To protect their crops and/or livestock from disease, which in turn protects their source of income.	• <i>Australia's economy</i>	To ensure agricultural production is profitable and that Australia's agricultural exports continue to be purchased internationally.	• <i>Everyday Australians</i>	To provide locally grown food options that are safe to consume, readily available and reasonably priced.
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17.5	1	<p><i>Your brainstorm may include some of the following ideas:</i></p> <ul style="list-style-type: none"> • New livestock • New seeds • Farm workers coming to and from the property • Equipment and vehicles that go to and from the property • Air and water that travel over / past the property • Wild animals 						

Chapter 17 [continued]

Section	Activity	Sample answers
17.5	2	Both pesticides and genetic engineering (GE) play an important role in preventing crop loss due to insect pests. Pesticides can be used to kill pests, reducing their population size and thus their ability to damage crops. GE can be used to give plants genes that combat known pests, e.g. BT cotton is a GE plant that produces toxins against the caterpillars that harm the cotton. Pesticides and genetic engineering should be complemented with other prevention methods, e.g. using farm biosecurity to avoid farm inputs that could cause disease and quarantine policies to prevent international pests spreading to Australia.
	3	<p>a) To ensure that the correct control measures are used for the specific cause of the sheep's death.</p> <p>b) The farmer could avoid using the paddock in which the sheep died for livestock, and if possible, avoid using the neighbouring paddocks also.</p> <p>c) No – they may also have anthrax or be carrying spores on their bodies. So, they should be kept separate to reduce the risk of anthrax occurring in other animals.</p> <p>d) <i>Multiple correct answers, including:</i></p> <ul style="list-style-type: none"> • Wear disposable gloves to protect hands. • Wear a facial mask to cover mouth and nose. • Wear a hazmat suit. • Dispose of or sterilise shoes/clothes worn during inspection/incineration. <p>e) Vaccinated animals will develop memory B and T cells specific to the anthrax pathogen, allowing a quick response to anthrax if exposed to it.</p> <p>f) The anthrax outbreak will reduce the farm's productivity and profits. The farmer will have to dedicate time and money towards vaccination programs, incinerating the dead sheep and altering paddock use. The farmer has also lost the five sheep that died, which reduces productivity and represents a loss of valuable livestock.</p>

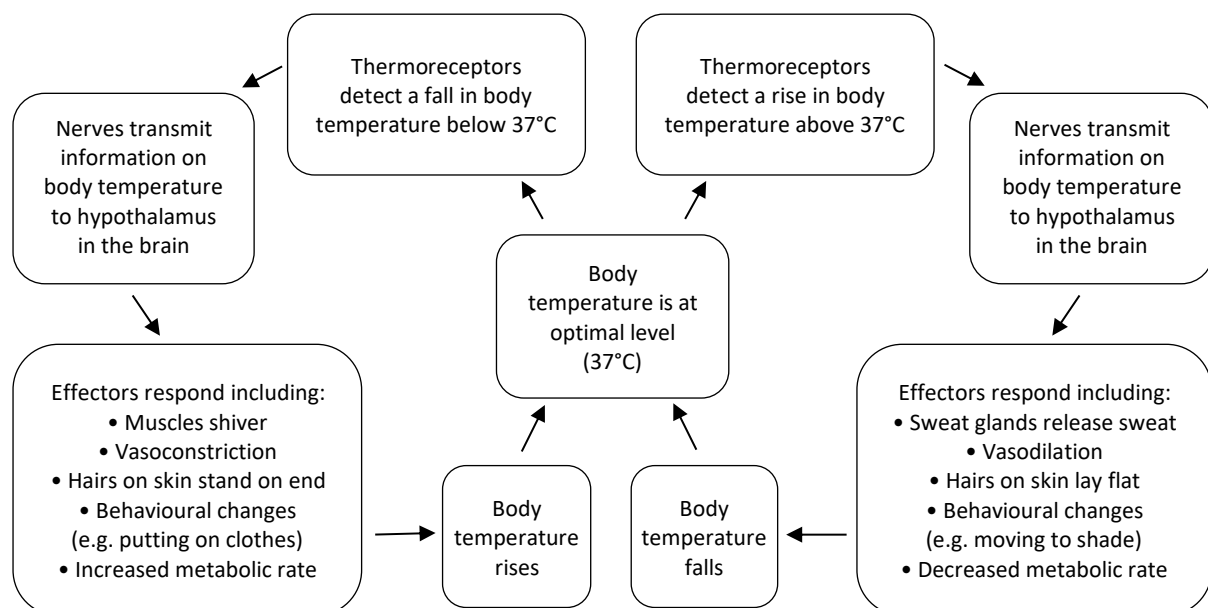
Module 8: Non-Infectious Disease and Disorders

Chapter 18

Section	Activity	Sample answers										
18.1	1	a) The maintenance of a stable internal state within an organism, in spite of environmental changes. b) The nervous and endocrine systems. c) Close to 37°C. d) Fluid and ion levels in the blood. e) They are excreted (i.e. the body removes these).										
	2	<i>Using the passage provided, answers include:</i> <ul style="list-style-type: none"> • Internal temperature • Blood volume • Blood pressure • Blood solute concentration • Blood pH • Blood-sugar level 										
	3	a) Ectotherms b) Endotherms c) When a variable triggers a counteracting response in order to bring the body back to a set point. d) Insulin and glucagon. e) When a variable triggers a response that intensifies the variable. f) Childbirth										
	4	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"><div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div></td> <td style="width: 50%; border: none;"><div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div></td> </tr> <tr> <td style="border: none;"><div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div></td> <td style="border: none;"><div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div></td> </tr> <tr> <td style="border: none;"><div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div></td> <td style="border: none;"><div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div></td> </tr> <tr> <td style="border: none;"><div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div></td> <td style="border: none;"><div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div></td> </tr> <tr> <td style="border: none;"><div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div></td> <td style="border: none;"><div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div></td> </tr> </table>	<div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div>	<div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div>	<div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div>	<div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div>	<div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div>	<div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div>	<div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div>	<div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div>	<div style="background-color: #d1ecf1; height: 20px; margin-bottom: 5px;"></div>	<div style="background-color: #f8d7da; height: 20px; margin-bottom: 5px;"></div>
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5	1. D 4. A 2. B 5. C 3. B 6. C											

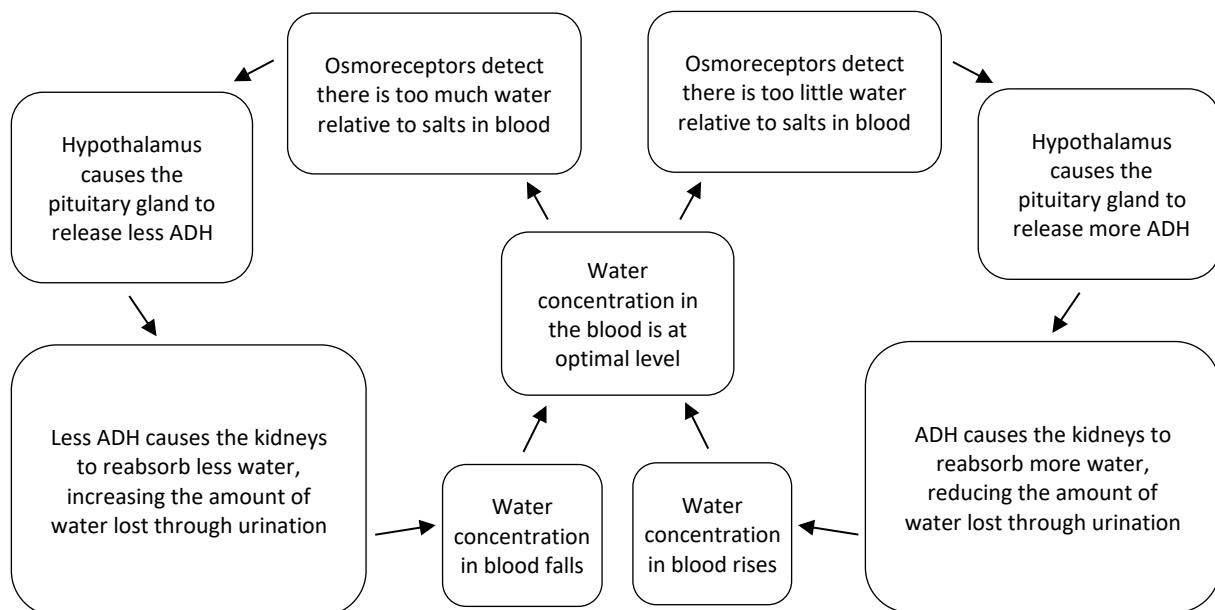
Chapter 18 [continued]

Section	Activity	Sample answers
18.1	6	a) Below the ribs, behind the stomach b) Islets of Langerhans c) When BGL is too high d) Excess glucose moves into cells and liver stops releasing sugar e) When BGL is too low f) The liver and cells release stored sugar into the blood g) Diabetes
18.2	1	<ul style="list-style-type: none"> • system • body • brain • external • heat • concentrations • subconscious • receptors • stimuli • eyes • transmit • centre • effector • response • hormones
	2	a) Information (from the internal or external environment) that provokes a response. b) A part of an organism that detects a stimulus and transmits it to the control centre. c) A control centre, such as the brain. d) A part of an organism that can respond to a stimulus, e.g. a muscle or a gland.
	3	The nervous system detects any changes from the stable state using sensory receptors to detect stimuli, e.g. a change in blood glucose concentration. A control centre (typically the brain) activates effectors to counteract these changes, e.g. by the pancreas releasing the hormone insulin.
18.3	1	<i>See the negative feedback loop below:</i>



Chapter 18 [continued]

Section	Activity	Sample answers
18.3	2	<p>a) Approximately 90 mg/100 mL</p> <p>b) Pancreas</p> <p>c) Alpha and beta cells</p> <p>d) Insulin</p> <p>e) (1) Rate of glucose uptake in body cells increases. (2) Liver stores sugar as glycogen.</p> <p>f) Glucagon</p> <p>g) The liver breaks down glycogen, releasing it as glucose into the blood.</p> <p>h) The pancreas and liver both help maintain BGL. They interact using hormones. The pancreas makes hormones that regulate BGL, while the liver responds to the hormones to either store, or release glucose.</p> <p>i) The alpha and beta cells act as both receptors and effectors for changes in BGL. This allows these cells to respond directly by releasing insulin or glucagon without involving a separate control centre.</p>
	3	<p>a) Osmoreceptors in the hypothalamus</p> <p>b) ADH</p> <p>c) The amount of water lost through urination is reduced, with more water being reabsorbed.</p> <p>d) The amount of water lost through urination is increased, with less water being reabsorbed.</p> <p>e) <i>See negative feedback loop below:</i></p>



Chapter 18 [continued]

Section	Activity	Sample answers
18.4	2	<p>a) Biological catalysts that are essential for maintaining metabolism.</p> <p>b) Higher than the optimal temperature will denature the enzyme and cause it to stop functioning. Lower temperatures can cause an enzyme to slow down or stop working.</p> <p>c) Being more acidic or more basic than the optimal pH will denature the enzyme and cause it to stop functioning.</p> <p>d) Enzymes are very sensitive to changes in temperature and pH. Enzymes are required to catalyse the metabolic reactions that keep us alive, e.g. respiration provides energy and digestion provides nutrition. Homeostasis ensures that the enzymes for such reactions can work efficiently by maintaining the optimal conditions for them.</p>
	3	<p>When receptors detect a change from the optimal condition, nerves typically send information from receptors to the CNS (e.g. the brain). The CNS then typically acts as a control centre to trigger effectors to respond to the change. Some responses use nerves, e.g. to move muscles, while other responses involve hormones, e.g. insulin and glucagon being used to alter blood glucose levels. Many responses require both the nervous and endocrine systems, e.g. the response to decreased body temperature can involve nerves constricting muscles to cause shivering and thyroid hormones increasing metabolic rate.</p>
18.5	1	<p>1:2, 2:4, 3:3, 4:1</p> <p><i>i.e. the definitions from top to bottom are for:</i></p> <ul style="list-style-type: none"> • Behavioural adaptation • Adaptation • Physiological adaptation • Structural adaptation
	2	<p>a) Behavioural</p> <p>b) Physiological</p> <p>c) Structural</p> <p>d) Physiological</p> <p>e) Physiological</p> <p>f) Behavioural</p>
18.6	1	<p>a) Endotherm e) Ectotherm</p> <p>b) Endotherm f) Ectotherm</p> <p>c) Ectotherm g) Endotherm</p> <p>d) Endotherm h) Ectotherm</p>

Chapter 18 [continued]

Section	Activity	Sample answers
18.6	2	<ul style="list-style-type: none"> • GRAPH A: Ectotherm • GRAPH B: Endotherm <p>The organism in Graph A has a body temperature that changes with the external temperature, as occurs for ectotherms.</p> <p>The organism in Graph B is able to maintain a relatively constant body temperature despite environmental changes, as occurs for endotherms.</p>
	3	As the external temperature increases, their metabolic rate decreases.
	4	a) Structural b) Large SA:V ratio c) Heat loss d) i) High SA:V ratio ii) Heat loss occurs as their blood flows through the network of capillaries in their ears. iii) They flap their ears to aid in heat loss.
18.7	5	a) Behavioural b) Physiological c) Behavioural d) Structural e) Physiological* f) Structural g) Behavioural h) Physiological
	1	a) Aves (birds) and Mammalia (mammals) b) 300 mya c) 550 mya d) The avian and mammalian classes have a relatively close evolutionary relationship, sharing a common ancestor 300 mya. However, birds are more closely related to reptiles than mammals. e) i) The conservation of organs across vertebrate classes suggest evolutionary descent from a common ancestor with these organs. ii) Rat – humans and rats are both mammals, while chickens are birds. All three have a liver, but the rat liver is more likely to be similar to the human, as they have a more recent common ancestor.
	2	1:2, 2:4, 3:1, 4:3 <i>i.e. the definitions from top to bottom are for:</i> <ul style="list-style-type: none"> • Pancreas • Hypothalamus • Kidneys • Liver

*Dogs pant as a reflex to heat and can do so even when unconscious e.g. under anaesthetic. The loss of heat via evaporative cooling during panting is a physiological process. It is unclear whether dogs can also consciously choose to pant – so panting is debatably a behavioural adaptation too.

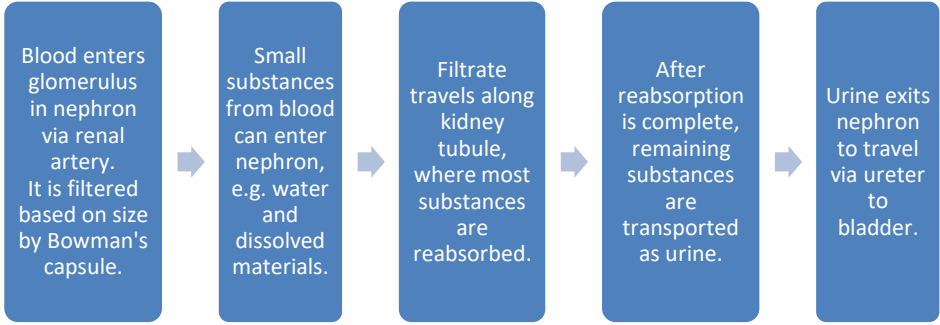
Chapter 18 [continued]

Section	Activity	Sample answers
18.7	3	<p>a) Yes (although in some it is not an organ, but just pancreatic tissue).</p> <p>b) Yes – having developed in a common ancestor, and since its role is so vital, the pancreas' function is likely to be similar.</p> <p>c) Given that insulin can be extracted from mammals such as cows and pigs, it suggests that their pancreases can also produce insulin.</p> <p>d) i) They have similar organs (as both are mammals) and are relatively closely related.</p> <p>ii) Despite both being mammals, there are many genetic differences between mice and humans that might affect the efficacy of a treatment.</p>
18.8	1	<ul style="list-style-type: none"> • stomachs • homeostasis • fat • available • regulation • hormones • hypothalamus • food • stable
	3	<p>a) Urination, breathing, sweating and defaecation (i.e. pooping).</p> <p>b) Hypothalamus</p> <p>c) Thirst encourages organisms to find a water source and consume water. The intake of water is vital to replace water lost by organisms, e.g. in urine. The correct amount of water is essential for maintaining multiple aspects of homeostasis, e.g. blood volume and blood pressure. So, thirst assists homeostasis by ensuring that fluids are consumed.</p>
18.9	1	<p>a) Decrease</p> <p>b) More acidic</p> <p>c) Increase</p> <p>d) More basic</p>
	2	<p>a) Blood pH will decrease to become more acidic if excessive amounts of carbon dioxide accumulate. Blood pH will increase to become more basic if excessive amounts of ammonia accumulate.</p> <p>b) Ammonia and carbon dioxide change blood pH. Both are waste products that must be excreted (removed) from the body. This helps to maintain a constant blood pH and so facilitates the optimal functioning of enzymes to ensure metabolic reactions occur quickly enough to sustain life.</p>
	3	<p>a) The removal of metabolic wastes and excess materials from the cells of an organism.</p> <p>b) Sweating, exhalation and urination.</p> <p>c) Faeces contains the wastes from the digestion of food, and does not contain the wastes from cellular metabolism.</p>

Chapter 18 [continued]

Section	Activity	Sample answers										
18.9	3	<p>d)</p> <table border="1"> <thead> <tr> <th><i>Carbon dioxide</i></th> <th><i>Nitrogenous wastes</i></th> </tr> </thead> <tbody> <tr> <td>Respiration</td> <td>By breaking down of proteins</td> </tr> <tr> <td>Exhalation</td> <td>As urine (mammals) / as a paste (birds)</td> </tr> <tr> <td>Lungs</td> <td>Kidneys</td> </tr> <tr> <td>Constantly</td> <td>1 or more times per day</td> </tr> </tbody> </table> <p>e) Excess water and salts need to be excreted as their build-up in the body would change the homeostatic balance of these substances and so affect the rate of metabolic reactions and blood pressure in the body.</p>	<i>Carbon dioxide</i>	<i>Nitrogenous wastes</i>	Respiration	By breaking down of proteins	Exhalation	As urine (mammals) / as a paste (birds)	Lungs	Kidneys	Constantly	1 or more times per day
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4	<p>a) Urea b) Uric acid c)</p> <table border="1"> <thead> <tr> <th><i>Urea</i></th> <th><i>Uric acid</i></th> </tr> </thead> <tbody> <tr> <td>Lower</td> <td>Higher</td> </tr> <tr> <td>Moderate</td> <td>Low</td> </tr> <tr> <td>Mammals, many adult amphibians and some marine species</td> <td>Insects, land snails, birds and many reptiles</td> </tr> </tbody> </table> <p>d) (i) Most water lost in urine needs to be replaced. Water loss is reduced by producing concentrated urine. This reduces the need to find a water source in drier environments. (ii) Physiological</p> <p>e) (1) Uric acid requires less water to dilute than urea, so it reduces water loss. (2) It is safer for any offspring that are developing in eggs.</p>	<i>Urea</i>	<i>Uric acid</i>	Lower	Higher	Moderate	Low	Mammals, many adult amphibians and some marine species	Insects, land snails, birds and many reptiles			
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Lower	Higher											
Moderate	Low											
Mammals, many adult amphibians and some marine species	Insects, land snails, birds and many reptiles											
18.10	1	<p>a) Upper abdominal area, below the ribs and against the back muscles. b) Nitrogenous wastes (e.g. urea), excess water and salts. c) Renal artery d) Renal vein e) Ureter</p>										

Chapter 18 [continued]

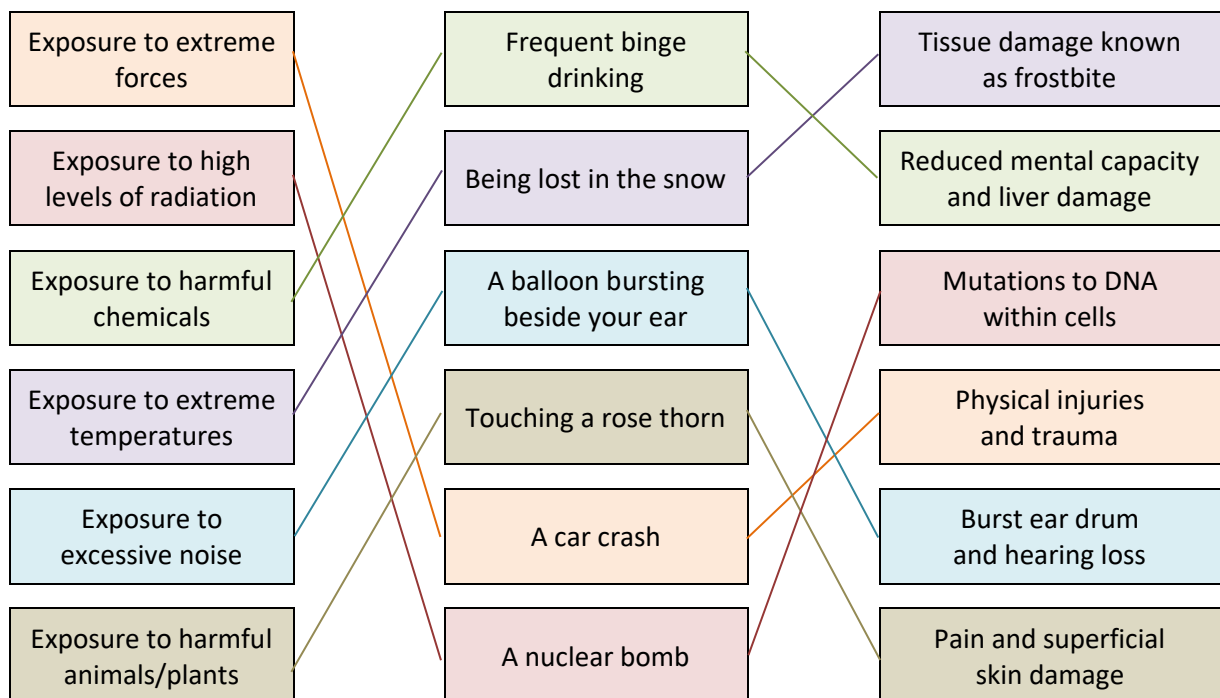
Section	Activity	Sample answers
18.10	2	a) 20-25 times b) Nephrons c) Around one million. d) It raises blood pressure. e) It increases red blood cell production.
	3	1. A 4. B 2. C 5. B 3. A 6. C
	4	
	5	a) The longer the loop of Henle, the more water is reabsorbed in a nephron. b) Organisms with limited access to drinking water in their usual habitat would be more likely to long loops of Henle, while organisms with ready access to drinking water would be likely to have shorter loop of Henle.
	18.11	1

Chapter 18 [continued]

<i>Section</i>	<i>Activity</i>	<i>Sample answers</i>
18.11	2	<ul style="list-style-type: none"> • homeostasis • health • stomata • exchange • absorbing • rainfall • dry • loss • water
	3	<ul style="list-style-type: none"> a) This increases their ability to absorb water from the soil. b) Exposure to sunlight increases water loss via transpiration. Reflective leaf surfaces reflect this sunlight, which reduces water loss. c) Air flow increases water loss via transpiration. These hairs reduce air flow and so reduce the amount of water lost by transpiration. d) During times of low access to water in the environment, such plants can use their water stores as a water source. e) This reduces the total the amount of water lost through the stomates via transpiration. f) This decreases the amount of water loss via transpiration. g) This reduces the amount of water lost through the stomates via transpiration. h) Waxy cuticles act as a waterproof barrier and so help to seal in the water, thus reducing water loss from transpiration.

Chapter 19

Section	Activity	Sample answers
19.1	1	a) • genetics • environment • physiological malfunctioning b) The causes of non-infectious diseases often involve multiple factors, e.g. although skin cancer involves environmental exposure to sunlight, which causes mutations that lead to cells malfunctioning, people with fair skin have a genetic predisposition to develop skin cancer.
	2	<p><i>The following examples of genetic diseases were mentioned in Modules 5 and 6 of 'Blitzing Biology 12':</i></p> <ul style="list-style-type: none"> • Sickle-cell disease • Cystic fibrosis • Colour blindness • Duchenne muscular dystrophy • Haemophilia • Down syndrome (Trisomy-21) • Sex chromosome abnormalities (e.g. Turner syndrome, Klinefelter's syndrome, Triple X syndrome and XYY syndrome) • Antithrombin-III deficiency (a blood clotting problem)
	3	See below:



Chapter 19 [continued]

Section	Activity	Sample answers									
19.2	2	<p>a) $\frac{300,000}{10,000} =$ approximately 30 cases per annum in newborns.</p> <p>b) Autosomal. It is caused by mutations to a gene on chromosome 12, an autosomal chromosome.</p> <p>c) (i) Recessive (ii) <i>Dd</i></p> <p>[Note: You could have used different letters, but you must have used one capital and one lowercase of the same letter to indicate a heterozygous genotype, since they are carriers.]</p> <p>(iii) <i>dd</i></p> <p>[Note: You could have used different letters, but you must have used two lowercase letters of the same letter to indicate a homozygous recessive genotype.]</p> <p>(iv) 25%</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td><i>D</i></td> <td><i>d</i></td> </tr> <tr> <td><i>D</i></td> <td><i>DD</i></td> <td><i>Dd</i></td> </tr> <tr> <td><i>d</i></td> <td><i>Dd</i></td> <td><i>dd</i></td> </tr> </table>		<i>D</i>	<i>d</i>	<i>D</i>	<i>DD</i>	<i>Dd</i>	<i>d</i>	<i>Dd</i>	<i>dd</i>
		<i>D</i>	<i>d</i>								
<i>D</i>	<i>DD</i>	<i>Dd</i>									
<i>d</i>	<i>Dd</i>	<i>dd</i>									
	3	<p>a) The gene for the PAH enzyme within the DNA would be transcribed into mRNA. This mRNA would leave the nucleus and travel to a ribosome in the cytoplasm. The ribosome would translate the gene, making a polypeptide from amino acids. This polypeptide would be processed to form the 3D protein, phenylalanine hydroxylase.</p> <p>b) The symptoms of PKU occur due to phe accumulating in the blood after consuming foods containing phe. If an individual modifies their diet so that it does not include any sources of phe, then phe cannot accumulate.</p> <p>c) (i) They lack the PAH enzyme, which is required to break down phe from the diet. So phe accumulates. (ii) There will be minimal phe available and so there should be little to no bacterial growth, as the bacterial species used requires phe. (iii) There should be moderate to high growth levels as the phe from the baby's blood will enable the bacteria to grow.</p> <p>d) The current screening test, followed by diet modification prevents symptoms of PKU occurring in affected individuals. However, these methods do nothing to prevent genetic inheritance of PKU. Hence these methods are ineffective at preventing PKU as a genetic condition, but are very effective in preventing symptoms of the condition.</p>									

Chapter 19 [continued]

Section	Activity	Sample answers
19.3	1	<p>a) Different – the incidence should be much lower than the prevalence, as people can still live for many years with diabetes.</p> <p>b) Different – the incidence should be lower than the prevalence, as many men live with prostate cancer for many years after diagnosis.</p> <p>c) Similar, as most infants with Edwards syndrome die soon after birth.</p>
19.4	1	<p>a) Genes that control growth & repair.</p> <p>b) It is faster (i.e. more rapid).</p> <p>c) (1) Ionising radiation (2) mutagenic chemicals. [Note: Your answer would also be correct if you named specific types of radiation or chemicals that act as mutagens.]</p> <p>d) <i>Multiple possible answers, including:</i></p> <ul style="list-style-type: none"> • Errors during DNA replication • Errors during cell division (mitosis/meiosis) • Exposure to mutagenic chemicals produced by cellular reactions <p>e) Any</p> <p>f) Thyroid cancer</p> <p>g) They have multiple mutations due to rapid cell division.</p> <p>h) Not necessarily.</p>
	2	<p>a) Surgery, radiation and chemotherapy.</p> <p>b) Frequently dividing cells.</p> <p>c) Both hair cells and skin cells divide frequently, so they are affected by these drugs as they are targeting rapidly dividing cells.</p>
	3	<p>a) They help to prevent cancer by detecting and repairing damage in DNA. They also trigger cell death in damaged cells that cannot be repaired.</p> <p>b) BRCA1</p> <p>c) No</p> <p>d) Family members of someone with the BRCA1 gene are more susceptible to having BRCA1 and developing hereditary breast/ovarian cancer.</p> <p>e) Screening tests help to detect a cancer at an earlier stage, reducing the risk of it being life-threatening. Surgery to remove breasts and/or ovaries removes the tissues that have a risk of cancer developing in them.</p>

Chapter 19 [continued]

Section	Activity	Sample answers
19.5	2	<ul style="list-style-type: none"> a) 99% b) Vaginal, vulva, penile, anal & throat cancer. c) Hundreds d) Nothing – it is usually asymptomatic (i.e. symptomless). e) Genital warts f) HPV 16 and HPV 18. g) 1991 h) Atypical cells (i.e. cell with changes). i) HPV infection
	3	<ul style="list-style-type: none"> a) Cancer-causing HPV strains invade cells in the cervix and produce a p53 inhibitor. This inhibitor deactivates the p53 protein, which is an important tumour suppressor gene. Without the p53 protein, cells with mutations successfully divide and can form tumours. b) The incidence and mortality of cervical cancer were high, but relatively constant in the 1980s, then decreased during the 1990s. This is possibly due to the introduction of free cervical screening tests in 1991. The incidence and mortality have remained lower and relatively constant in the 2000s. The mortality has always been much lower than the incidence, suggesting many cases of cervical cancer do not cause death.
	5	<ul style="list-style-type: none"> 1. D 5. A 2. C 6. A 3. C 7. B 4. D 8. B
	6	<ul style="list-style-type: none"> a) The use of government funding in combination with vaccine delivery within schools is an effective way to ensure that the majority of young Australians are vaccinated against HPV. Treating diseases such as cervical cancer is expensive. So over time, the government funding of the vaccine program will probably be recovered in reduced treatment costs. b) Most cases (45%) start to be diagnosed in people aged 30-49 years, followed by the group aged 50-69 years. The HPV vaccination program did not start until 2007, so no one from this is over 30 years yet for the incidence to change. c) Around 2024-2025 – as the first people given HPV vaccine were 12-13 years in 2007, and so will be 30 years in 2024-2025. <p>[Note: You may have given another year or range of years. Your answer will need to be after 2024 and relate to the age of diagnosis and the age of individuals who were vaccinated following 2007.]</p>

Chapter 19 [continued]

Section	Activity	Sample answers
19.5	6	<p>d) Australia will not be able to completely eradicate cervical cancer. However, the incidence should become very low due to the use of the vaccine and screening program, as over 99% of cervical cancer cases are linked to having HPV. However, cervical cancer can still occur without being linked to HPV, and some people may not get vaccinated or may contract HPV prior to being vaccinated.</p> <p>[Note: The new cervical cancer screening program tests for HPV in cervical cells. If HPV is detected, increased monitoring will help detect atypical cells before cancer develops. However, this test will not readily detect or prevent the rare cervical cancer cases that are not caused by HPV.]</p>
19.6	2	<p>a) <i>Non-infectious diseases include:</i></p> <ul style="list-style-type: none"> • Road injury • Diabetes • Trachea, bronchus, lung cancers • Alzheimer’s disease and other dementias • Chronic obstructive pulmonary disease • Stroke • Ischaemic heart disease <p><i>Infectious diseases include:</i></p> <ul style="list-style-type: none"> • Tuberculosis • Diarrhoeal diseases • Lower respiratory infections. <p>b) Non-infectious diseases</p> <p>c) Everyone has to die from either an infectious or a non-infectious cause. So, if infectious diseases are prevented and/or treated effectively, this means that people will instead be dying from a non-infectious cause.</p>
	3	<p>a) <i>Some patterns and trends you may have found in your research include:</i></p> <ul style="list-style-type: none"> • Ischaemic heart disease and stroke are major causes of death in all economies – high, middle and low. • Low-income economies have significantly more deaths due to infectious disease than middle or high-income economies. • Road injury and birth complications are major causes of death in low and middle-income countries, but not in high-income countries. • Many of the major causes of death in low-income countries are considered preventable or treatable, e.g. malaria and diarrhoeal diseases.

Chapter 19 [continued]

<i>Section</i>	<i>Activity</i>	<i>Sample answers</i>
19.6	3	<p>b) <i>Multiple correct answers, for example:</i></p> <ul style="list-style-type: none">• Wealthier economies are more financially able to provide health care for their citizens.• Many preventative options (e.g. vaccines) and treatments (e.g. antibiotics) are expensive.• Many aspects of public hygiene are affected by government provisions or lack thereof, e.g. access to clean drinking water.• Wealthier countries have increased jobs available in safe industries, such as finance and consulting. In contrast, low-income countries have increased factory and labour-based jobs available, which have greater risk for work-related health problems and/or injuries. <p>c) Higher rates of infectious disease occur in countries with low-income economies. These same countries also have much lower life expectancies, e.g. India, and countries in Africa and south-east Asia.</p>

Chapter 20

Section	Activity	Sample answers
20.1	2	<ul style="list-style-type: none"> • diseases • people • cause • responses • invest • health • data • analysed • reduce • methods • prevalence • studies • risk
	3	a) F b) T c) F d) T e) T f) T g) F h) T
20.2	1	a) The number of ice cream sales and shark attacks both increase and peak in December/January, then decrease to a minimum in June/July. b) Correlation – the maxima and minima for numbers of ice cream sales and shark attacks occur closely together. Since this could be a coincidence or due to other variables, there is not enough data to determine causation. c) <i>Multiple correct answers, for example:</i> <ul style="list-style-type: none"> • Both ice cream sales and shark attacks increase during the summer months, which probably means that temperature might have an impact on both of these variables. • The pattern could just be a coincidence.
	2	No – this statistic indicates a strong correlation between smoking and being an alcoholic. However, it does not provide any evidence of a cause and effect relationship existing between them.
	3	a) <i>Multiple correct answers, for example:</i> <ul style="list-style-type: none"> • Food may have been contaminated with pathogens and not cooked sufficiently to kill these pathogens. • Poor personal hygiene by the chefs or waitstaff could have transferred pathogens from the staff to the family's food. • Cutlery or plates may have been contaminated or inadequately washed, allowing pathogens to be transferred from prior customers to the family. b) <i>Multiple correct answers, for example:</i> <ul style="list-style-type: none"> • One member of the family may have been exposed to the causative pathogen at work or school, and then spread it to the rest of the family. • The family's house may be contaminated with a source of pathogens or an environmental toxin.

Chapter 20 [continued]

Section	Activity	Sample answers
20.2	3	<p>c) <i>Multiple correct answers, for example:</i></p> <ul style="list-style-type: none"> • Faecal samples from the family could be sent to a pathology lab to identify if a pathogen is present. • Other customers of the restaurant could be contacted to find out if anyone else who was at the restaurant has become unwell. • The family could be interviewed to find out what they ordered and whether there was a common food item shared at the restaurant. • Other people in the family's work / school environments could be contacted to find out if anyone else has had similar symptoms. • Staff of the restaurant could be questioned about their recent health. • Food samples and surfaces could be tested for pathogens in the restaurant.
	4	<p>Although there is a high correlation between the brand of pet food and the dogs developing megaesophagus, this does not provide sufficient evidence to prove that the food is the cause of the disease. Further investigation will help to determine if it is the actual cause, or just a coincidence. It might also reveal other possible causes or contributing factors.</p> <p>[Note: If the food is the cause of the disease, it will be beneficial to determine the specific part of the food that is causative, so as to remove it and ensure no other types of dog food contain this substance or substances.]</p>
20.3	1	<p>a) This graph provides very limited evidence on the role of cigarettes in causing lung cancer. The graph portrays a clear correlation between cigarettes smoked and lung cancer incidence approximately 20 years later. However, this data alone cannot indicate if a causal relationship exists, nor provide insight into the role of cigarettes in causing cancer.</p> <p>b) Cigarettes cause damage that accumulates over time, so the effects of increasing rates of smoking are not immediately apparent in death rates.</p> <p>c) Data on the number of cigarettes smoked may come from the taxes collected on cigarette sales or from company records. Data on lung cancer deaths may come from various health authorities.</p>
	2	<p>a) Mechanisation and mass marketing</p> <p>b) Lung cancer was quite rare until the 20th century. Earlier cases were probably misdiagnosed as TB or pneumonia, etc. So when the number of cases began to increase in the 1920s, they did not know why, or what was causing it.</p>

Chapter 20 [continued]

Section	Activity	Sample answers										
20.3	2	<p>c)</p> <table border="1"> <thead> <tr> <th>Line of evidence</th> <th>Brief description of approach and main findings</th> </tr> </thead> <tbody> <tr> <td>Population studies</td> <td> 1) Groups of demographically matched smokers and non-smokers had their health tracked over time, 2) Lifestyles of people with lung cancer were compared to those without lung cancer Findings: smoking was correlated with lung cancer. </td> </tr> <tr> <td>Animal experimentation</td> <td> <ul style="list-style-type: none"> Giving animals ‘tobacco juice’ had been causally linked to cancer in the animals. Painting the shaved fur patches on mice with cigarette tar was shown to cause tumours </td> </tr> <tr> <td>Cellular pathology</td> <td>Pathologists observed that cigarette smoke could cause ciliastasis (death of the cilia on cells lining the respiratory tract) and that lung cancers tended to occur in places where ciliastasis had also occurred.</td> </tr> <tr> <td>Cancer-causing chemicals in cigarette smoke</td> <td>Analysis of the exact chemicals in cigarette smoke revealed multiple known carcinogens to be present, e.g. benzopyrene, arsenic, chromium and polycyclic aromatic hydrocarbons.</td> </tr> </tbody> </table>	Line of evidence	Brief description of approach and main findings	Population studies	1) Groups of demographically matched smokers and non-smokers had their health tracked over time, 2) Lifestyles of people with lung cancer were compared to those without lung cancer Findings: smoking was correlated with lung cancer.	Animal experimentation	<ul style="list-style-type: none"> Giving animals ‘tobacco juice’ had been causally linked to cancer in the animals. Painting the shaved fur patches on mice with cigarette tar was shown to cause tumours 	Cellular pathology	Pathologists observed that cigarette smoke could cause ciliastasis (death of the cilia on cells lining the respiratory tract) and that lung cancers tended to occur in places where ciliastasis had also occurred.	Cancer-causing chemicals in cigarette smoke	Analysis of the exact chemicals in cigarette smoke revealed multiple known carcinogens to be present, e.g. benzopyrene, arsenic, chromium and polycyclic aromatic hydrocarbons.
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Cancer-causing chemicals in cigarette smoke	Analysis of the exact chemicals in cigarette smoke revealed multiple known carcinogens to be present, e.g. benzopyrene, arsenic, chromium and polycyclic aromatic hydrocarbons.											
	4	<p>a) Over the past 30 years, the % of Australians who smoke has decreased.</p> <p>b) The graph’s data indicates a correlation between various tobacco control measures and the decrease in % of Australians who smoke. There is insufficient data in the graph to determine whether the decrease in smoking rates are a direct result of the control measures, so a causal relationship cannot be determined from this data alone.</p> <p>c) Answer will vary according to the individual.</p> <p>d) Knowledge provided to nicotine addicts from public health initiatives cannot reduce or remove the symptoms of their addiction. These symptoms reduce one’s self-control and increase one’s desire to smoke. This limits the ability of some public health initiatives to alter the smoking habits of those heavily addicted.</p> <p>e) Almost 25%.</p> <p>f) Around 12% of Australians currently smoke, putting them at a significant risk of lung cancer. In 1991, 25% of Australians smoked. While the percentage of Australians who smoke has decreased since 1991, many people who smoked in 1991 may still be alive presently and at a significant risk of lung cancer due to their smoking history.</p>										

Chapter 20 [continued]

Section	Activity	Sample answers
20.4	2	a) F b) T c) F d) T e) T
	4	<p><i>Type 1 diabetes</i></p> <ul style="list-style-type: none"> • Involves an auto-immune response • Usually diagnosed in childhood • Seems to be inherited <p><i>Type 2 diabetes</i></p> <ul style="list-style-type: none"> • More common • Can initially be managed by changing lifestyle factors (e.g. diet and exercise) • Lifestyle elements are considered risk factors for this condition <p>Intersection:</p> <ul style="list-style-type: none"> • Involves problems maintaining blood-glucose level • Can be treated with insulin • Involves problems with pancreas
	5	a) 10% b) It only shows the incidence for insulin-treated types of diabetes. Many people with Type 2 and gestational diabetes can manage their condition through lifestyle changes and so would not be recorded in this data. c) Gestational diabetes usually resolves at the end of a pregnancy. So its prevalence does not grow annually. Other forms of diabetes have a growing prevalence that is significantly greater than gestational diabetes, as people can live with these types for many years.
6	a) Diabetes is more prevalent in older age groups, with the highest prevalence in people aged 75+ years. b) Diabetes is more prevalent in males than females for people aged 55 years and over. Diabetes prevalence is quite similar in men and women under 55 years. c) No – this data shows a correlation between age/gender and diabetes, but it does not contain data that indicates these can cause diabetes. d) This data is useful, but cannot be completely relied on as it was collected by self-reporting. It is limited as people may have accidentally or deliberately provided false information about their age, gender and if they have diabetes or not. [Note: Other limitations include: Some people may not know they have diabetes. Some people may not yet have been diagnosed as having diabetes. Other people may know they have diabetes, but have not reported this.]	

Chapter 20 [continued]

Section	Activity	Sample answers
20.4	7	The prevalence of diabetes has increased from around 1.5% of Australians in 1990 to nearly 5% in 2015. The increase has been relatively constant, except between 2007-2011, where the growth rate levelled off.
	8	<p>a) The prevalence of insulin-treated type 2 diabetes will still increase, but at a decreasing rate due to the decrease in incidence in recent years.</p> <p>b) <i>Possible reasons that could be investigated from the list are:</i></p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Alternative treatments are being used instead of insulin for some cases <input checked="" type="checkbox"/> Diet and exercise have improved across the population in recent years <p>c) Insulin is a prescription medicine that requires individuals using this treatment to interact with medical facilities, such as a GP or a medical centre. These medical facilities facilitate the collection of such data by reporting it to government organisations.</p>
	9	The incidence of insulin-treated type 2 diabetes correlates with SES. As SES decreases, the incidence of diabetes increases. Non-indigenous people and people living in major cities have a lower incidence of diabetes relative to indigenous people and people living outside of major cities respectively.
	10	<p>A number of risk factors are implicated as possible causes for type 2 diabetes, as well as genetic predisposition. However, the exact cause of diabetes is not fully understood. The prevalence of type 2 diabetes in Australia is very high and increasing. It is one of the leading causes of death in Australia.</p> <p>Epidemiological studies are essential to help better understand the cause of diabetes, the efficacy of different treatments and prevention methods. Government investment in these may be able to reduce deaths due to diabetes and may also be able to reduce the costs associated with treating and managing diabetes.</p>
20.5	1	<p>a) The human insulin produced by GE microbes is identical to the insulin produced by the pancreas. Hence it can work in the same way to reduce the BGL for type 2 diabetics.</p> <p>b) Reducing obesity through diet and exercise will help combat this risk factor for diabetes. Avoiding foods that cause a sudden glucose-spike will help to reduce the need for strong insulin responses to manage the BGL.</p>

Chapter 20 [continued]

Section	Activity	Sample answers
20.5	2	<p>a) Diabetes is a major cause of death worldwide and there are many people whose quality of life is impacted by diabetes. Research is necessary to determine the exact cause of diabetes and to try to find more effective preventions, treatments and/or a cure.</p> <p>b) Beta cells in the pancreas are responsible for producing insulin to help manage BGL in healthy individuals.</p> <p>c) <i>Many possible answers, for example:</i></p> <ul style="list-style-type: none"> • DNA sequencing to analyse the gene(s) that predispose people to diabetes. • Animal models to better understand the way different types of sugars in food impact health (e.g. fructose vs glucose vs sucrose). • Long-term epidemiological studies tracking patterns between generations of families to further understand if epigenetics is contributing to risk of diabetes.
20.6	1	<p>a) Non-infectious, as it has not spread to family members of the affected individuals and only a small proportion of the preschool are affected.</p> <p>b) This allows the two groups to be compared to try to identify patterns and trends that indicate factors that are correlated with having the disease.</p> <p>c) This will help to assess if there are any possible risk factors in the environment that may have led to the disease outbreak, e.g. a recent pest fumigation.</p> <p>d) <i>Your answer for this question needs to be backed by reasoning, e.g.</i></p> <ul style="list-style-type: none"> • Yes – the preschool is suspiciously correlated with the outbreak of this disease. Temporary closure will probably prevent further cases. • No – the disease has not been proven to be linked to the preschool and the cases occurring at the preschool could just be a coincidence. <p>e) Removal of the fungus should be arranged by people with proper expertise in safely removing such health hazards. Advice should be sought on an appropriate fungicide that is safe for people to be near and that can be sprayed to prevent the fungus growing back.</p>
	2	A valid study should have all variables kept constant, other than the intended independent variable. However, for any study involving humans, individual differences between participants are difficult to keep constant. Increasing the number of participants and ensuring the demographics of the two groups are similar helps to reduce the impact of individual differences among participants on the results. This helps to improve validity.
	3	This is your own design! There are multiple correct approaches. Make sure that you use large sample sizes and collect data from both affected and unaffected individuals.

Chapter 20 [continued]

Section	Activity	Sample answers
20.7	1	a) reliability b) epidemiology c) evaluating d) validity e) validity f) evaluating g) reliability
	2	<p><i>Examples of suitable answers include:</i></p> <p>SIMILARITIES:</p> <ul style="list-style-type: none"> • Both can help to determine the cause of a disease. • Both involve a systematic approach. • Both may involve patient samples and studying/comparing individuals who are healthy and diseased. <p>DIFFERENCES:</p> <ul style="list-style-type: none"> • Koch's postulates can only determine the cause of infectious diseases where the pathogen can be isolated in a culture. Epidemiological studies can be used to study all types of disease. • Koch's postulates only consider the cause of the disease being studied, while epidemiological studies may consider the cause, patterns in incidence, prevention, treatment and control.
	3	<p><i>There are multiple possible correct answers, for example:</i></p> <p>Epidemiological studies allow better disease prevention, by assisting research into risk factors and strategies to prevent the disease, e.g. epidemiological data helped to show that cigarette smoking causes lung cancer, prompting changes to smoking laws and government campaigns to reduce smoking rates. Similarly, epidemiological studies of diabetes helped identify lifestyle risk factors (e.g. poor diet and lack of exercise). This prompted improved education, public health initiatives, and investment into research on diabetes.</p>

Chapter 20 [continued]

<i>Section</i>	<i>Activity</i>	<i>Sample answers</i>
20.10	1	<p>a) IVF can screen for chromosomal abnormalities. It can also screen for certain specific genetic diseases, e.g. cystic fibrosis.</p> <p>b) A few cells from each embryo are taken prior to implantation and tested. This testing can involve chromosome testing using Next Generation Sequencing to check for chromosomal abnormalities. Karyomapping can also be used to screen for some specific single gene disorders.</p>
	3	<ul style="list-style-type: none"> • editing • Cas9 • bacteria • viruses • two • enzyme • cut • guide • sequence • corresponding • location • damage • repair • mutation • stop
	4	<p>a) This could cause DNA to be cut from an unintended location, resulting in a mutation in the genome. This can result in either no protein being produced, or an altered protein being produced.</p> <p>b)</p> <ul style="list-style-type: none"> • Experiments using CRISPR-Cas9 may have unintended consequences (causing severe health defects). • The embryo cannot consent to the procedure. • Perfecting this process may cause many embryos to die. • This technology could lead to ‘designer babies’. <p>c) Make sure that you answer the actual question, i.e. you write either ‘prevention’ or ‘treatment’. You then need to justify your decision.</p>

Chapter 21

Section	Activity	Sample answers												
21.1	2													
	3	<p>1:2, 2:4, 3:1, 4:5, 5:3</p> <p><i>i.e. the definitions from top to bottom are for:</i></p> <ul style="list-style-type: none"> • Pupil • Sclera • Conjunctiva • Iris • Cornea 												
	4													
	5	<p>1:3, 2:2, 3:4, 4:1</p> <p><i>i.e. the definitions from top to bottom are for:</i></p> <ul style="list-style-type: none"> • Optic nerve • Aqueous & vitreous humour • Lens • Retina 												
	6	<table border="0"> <tr> <td>a) Pupil</td> <td>g) Lens</td> </tr> <tr> <td>b) Iris</td> <td>h) Ciliary muscles</td> </tr> <tr> <td>c) Conjunctiva</td> <td>i) Sclera</td> </tr> <tr> <td>d) Retina</td> <td>j) Cornea</td> </tr> <tr> <td>e) Optic nerve</td> <td></td> </tr> <tr> <td>f) Aqueous humour and/or vitreous humour</td> <td></td> </tr> </table>	a) Pupil	g) Lens	b) Iris	h) Ciliary muscles	c) Conjunctiva	i) Sclera	d) Retina	j) Cornea	e) Optic nerve		f) Aqueous humour and/or vitreous humour	
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Small	Large													

Chapter 21 [continued]

Section	Activity	Sample answers										
21.1	8	<ul style="list-style-type: none"> • rays • retina • clear • near • shape • point • focusing • more • contracting • slacken • far • ciliary • ligaments • pull • thinner 										
	10	<pre> graph TD A[Light enters eye and passes through thin conjunctiva] --> B[Light passes through cornea, which refracts (bends) the light] B --> C[Light passes through pupil] C --> D[Light passes through lens, which refracts (bends) light to focus it on the retina] D --> E[Retina detects and converts light impulses into electrical stimuli] E --> F[Optic nerve carries electrical impulses from retina to brain] F --> G[Brain interprets electrical impulses to create an image] </pre>										
21.2	2	<table border="1"> <thead> <tr> <th>Myopia</th> <th>Hyperopia</th> </tr> </thead> <tbody> <tr> <td>... in the distance</td> <td>... up close</td> </tr> <tr> <td>... in front</td> <td>... behind</td> </tr> <tr> <td>... long</td> <td>... short</td> </tr> <tr> <td>... steep</td> <td>... flat</td> </tr> </tbody> </table>	Myopia	Hyperopia	... in the distance	... up close	... in front	... behind	... long	... short	... steep	... flat
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... long	... short											
... steep	... flat											
3	<p>a) The curve of the cornea is asymmetrical. b) The curve of the lens is asymmetrical. c)</p> <p>Light focuses in two places, causing blurry vision.</p>											

Chapter 21 [continued]

Section	Activity	Sample answers
21.2	4	<p>a) The lens gets stiffer and less flexible, making it difficult for the eye muscles to pull the lens into shape.</p> <p>b) 40+ years</p> <p>c) To see far objects, the ciliary muscles relax to cause the lens to become thinner. To see close objects, the ciliary muscles contract to cause the lens to become rounder.</p> <p>d) The lens becomes too stiff to change shape correctly, affecting the ability of light to focus on the retina at the correct spot.</p> <p>e) Multifocal glasses, multifocal contact lenses, readers and eye glasses (i.e. magnifying glasses).</p> <p>[Note: Bifocal glasses are also another treatment option with both near and far focal lengths.]</p>
	6	<p>a) Concave</p> <p>b) Convex</p> <p>c) Convex</p> <p>d) Concave</p> <p>e) Convex</p> <p>f) Convex</p> <p>g) The retina</p>
	7	<p>1. B 4. C</p> <p>2. D 5. C</p> <p>3. A 6. A</p>
	8	<p>a) Hyperopia is a condition where light focuses beyond the retina when looking at close objects. A convex lens makes the light converge more before entering the eye, so that it comes to a focus point on the retina.</p> <p>b) Myopia is a condition where light focuses in front the retina when looking at far objects. A concave lens makes the light diverge more before entering the eye, so that it comes to a focus point on the retina.</p>

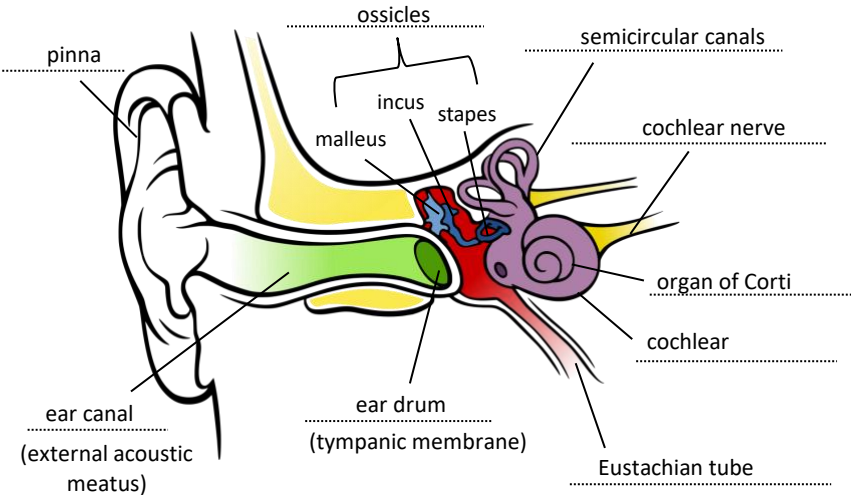
Chapter 21 [continued]

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21.3	1	<p>a) Cool</p> <p>b) Ultraviolet</p> <p>c) The first procedure may not provide perfect vision due to over-correction or under-correction, and eyesight might be blurry. So sometimes a second procedure is needed to achieve perfect vision. There is always a small risk of partial or complete blindness.</p> <p>[Note: Some people experience post-operative night vision problems, such as night glare, halos and star bursts around night lights. These are usually short-term, but can be longer-lasting for some people.]</p>									
	2	<p><i>From top to bottom the numbers are:</i></p> <p>• 4 • 3 • 2 • 1 • 6 • 5</p>									

Chapter 21 [continued]

Section	Activity	Sample answers
21.3	3	<p>a) Each individual will have slight variations in the shape of their cornea that cause their vision disorder, so will require unique re-shaping to correct their vision.</p> <p>[Note: The re-shaping needs to be very precise and specific to each person's eyes to ensure light will focus on their retina.]</p> <p>b) Vision can change due to growth, as this can change the shape of the eye. Laser eye surgery is not worthwhile if growth or any vision changes are occurring, as it will not provide long-term treatment.</p> <p>c) Laser eye surgery will correct Sally's myopia, but she may soon have poor vision due to presbyopia, as she is 40 years old. She would then need to wear glasses to correct this problem, or have more laser eye surgery.</p> <p>d) Laser eye surgery (LES) provides a cure, while glasses provide a treatment. Glasses have fewer risks, while LES can have unpleasant side-effect, e.g. blurring, halos around lights and, in rare cases, can cause blindness. LES is more expensive, cannot be done until about 20 years old, and due to presbyopia it only provides clear vision until about 40 years old. Glasses can be worn at all ages and are more easily adjusted as vision changes.</p>
	4	<p>The affected lens is surgically removed under local anaesthetic using ultrasound to soften it, then it is removed from the eye by suction. A new artificial lens is then implanted. This can be performed as day surgery.</p> <p>[Note:</p> <ul style="list-style-type: none"> • A cataract can also be removed with laser-assisted technology. • The synthetic lens is incapable of accommodation like the natural lens, so the patient may still need to use spectacles for near sight, such as for reading.]
21.4	1	• vibration • energy • waves • air • ear • detect • nerves • balance
	3	<p>a) • soft • low pitch</p> <p>b) • loud • low pitch</p> <p>c) • soft • high pitch</p> <p>d) • loud • high pitch</p>

Chapter 21 [continued]

Section	Activity	Sample answers
	2	
21.5	3	<p>The following six steps are quoted from <i>The interactive ear</i> – by Amplifon (n.d.):</p> <ol style="list-style-type: none"> 1. Pinna collects sound waves which pass through ear canal. 2. Waves reach ear drum causing it to vibrate. 3. Vibrations then pass to the middle ear (ossicles). 4. Ossicles amplify the noise and pass it to the inner ear. 5. Vibrations pass through the fluid of cochlea, making tiny hairs move. 6. This causes electrical signals to travel through the auditory nerve, to your brain.
	4	<ol style="list-style-type: none"> a) Pinna b) Ossicles c) Ear drum (OR tympanic membrane) d) Cochlear nerve (OR auditory nerve) e) Ear canal (OR external acoustic meatus) f) Ear drum (OR tympanic membrane OR typanum) g) Organ of Corti (which is within the cochlea) h) Semicircular canals i) Cochlea j) Eustachian tube

Chapter 21 [continued]

Section	Activity	Sample answers										
21.5	7	<p>a) When sound waves in the ear canal reach the ear drum, it vibrates at the same frequency. It passes these vibrations on to the middle ear bones.</p> <p>b) The ossicles receive vibrations from the ear drum. They amplify these vibrations and pass them on to the fluid in the inner ear.</p> <p>c) The organ of Corti in the inner ear contains hair cells that can detect vibrations. The movement of the hair cells causes their cilia to vibrate. These vibrations are converted into electrical nerve impulses that can be sent along the cochlear nerve to the brain to be interpreted as sound.</p>										
21.6	1	<p>a) No</p> <p>b) Hair cells in the inner ear can be damaged by exposure to noise. The hair cells for higher pitches are the first to encounter sound waves, and so experience more stress over time from noise exposure. This causes them to degenerate earlier than hairs for lower pitches.</p>										
	2	<table border="1"> <thead> <tr> <th>Type of hearing problem</th> <th>Location of the source of the hearing problem</th> </tr> </thead> <tbody> <tr> <td>Conductive hearing loss</td> <td>External or middle ear</td> </tr> <tr> <td>Sensorineural hearing loss</td> <td>Inner ear</td> </tr> <tr> <td>Mixed hearing loss</td> <td>External or middle ear AND inner ear</td> </tr> <tr> <td>Auditory processing disorders</td> <td>Brain</td> </tr> </tbody> </table>	Type of hearing problem	Location of the source of the hearing problem	Conductive hearing loss	External or middle ear	Sensorineural hearing loss	Inner ear	Mixed hearing loss	External or middle ear AND inner ear	Auditory processing disorders	Brain
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3	<p>a) (i) A build-up of ear wax in the ear canal would block some of the sound waves entering the ear canal from reaching the ear drum. (ii) Conductive</p> <p>b) (i) Fluid in the middle-ear would interfere with the ossicles being able to vibrate correctly to amplify sound entering the inner ear. (ii) Conductive</p> <p>c) (i) The hair cells are required to convert sound vibrations into nerve impulses. Damage to some of the hair cells will prevent hearing frequencies for which those hair cells function. (ii) Sensorineural</p> <p>d) (i) <i>Multiple correct answers, e.g. wear ear muffs or use ear plugs.</i> (ii) <i>Multiple correct answers, e.g. not standing near loudspeakers at events, wearing ear plugs at music concerts, only using low volumes with headphones, wearing ear muffs if working with noisy equipment, etc.</i></p>											

Chapter 21 [continued]

Section	Activity	Sample answers																					
21.6	4	<p>a) Conductive</p> <p>b) Mitosis (cell division)</p> <p>c) The ear drum is a barrier to entry for bacteria. A hole in it would allow the barrier to be penetrated, increasing risk of middle ear infections.</p> <p>d) A grommet would allow pressure in the middle ear to be released through the ear drum into the external ear, preventing any build-up of pressure inside the middle ear that could burst the ear drum.</p>																					
	5	<p><i>Some causes of hearing loss that can be added to the mind-map include:</i></p> <ul style="list-style-type: none"> • Age related damage to hair cells • Auditory processing problems in brain • Build-up of ear wax • Fluid build-up in the middle ear, e.g. due to a cold • Excessive exposure to noise damaging the hair cells • Bursting the ear drum • Fluid in the middle ear • Poor Eustachian tube function • Ear infection • Allergies • Perforated eardrum • Infection in the ear canal • Swimmer’s ear • Foreign body in ear • Malformation of outer ear, ear canal or middle ear. 																					
21.7	2	<p>1:2, 2:1, 3:3</p> <p><i>Technologies from top to bottom are:</i></p> <ul style="list-style-type: none"> • Bone conduction implant • Hearing aid • Cochlear implant 																					
	3	<table border="1"> <thead> <tr> <th colspan="2"></th> <th>External ear</th> <th>Middle ear</th> <th>Inner ear</th> <th>Cochlear nerve</th> </tr> </thead> <tbody> <tr> <th rowspan="3">Hearing technology</th> <td>Hearing aid</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Bone conduction implant</td> <td></td> <td></td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Cochlear implant</td> <td></td> <td></td> <td></td> <td>✓</td> </tr> </tbody> </table>			External ear	Middle ear	Inner ear	Cochlear nerve	Hearing technology	Hearing aid	✓	✓	✓	✓	Bone conduction implant			✓	✓	Cochlear implant			
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Chapter 21 [continued]

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	5	<p>Hearing aids increase the volume of sound waves entering the ear canal and so can improve hearing for people with various hearing loss conditions. However, hearing aids do not pick up all frequencies, nor do they work very well if there is too much background noise. Hearing aids are relatively cheap, do not require surgery and can be adjusted to selectively detect frequencies for which hearing loss has occurred. However, hearing aids rely on the natural mechanisms of hearing and so it is essential that the ear drum, middle ear and inner ear are still functional.</p>																																																
	6	<p>a) <i>Multiple correct answers, including:</i></p> <ul style="list-style-type: none"> • Pitch and timbre are difficult to hear. • Tonal languages are difficult to understand, e.g. Chinese • It is difficult to isolate one voice talking in a crowd. • The implant has around 20 sound channels, unlike normal hearing that has thousands of different hair cells to hear. • Training is often required to learn how to 'hear' using the implant. • The speech processor is specialised to pick up sound frequencies involved in speech, rather than all sounds. This reduces the hearing experience of many other types of sound. <p>b) Cochlear implants detect sound and convert it into electrical impulses. They do not use a speaker to produce any sound waves, and so are silent.</p>																																																

Chapter 21 [continued]

Section	Activity	Sample answers
21.7	7	<p><i>This question can be answered in multiple ways. It is important to include:</i></p> <ul style="list-style-type: none"> • <i>a clear evaluation statement on the efficacy of cochlear implants</i> • <i>benefits AND limitations to justify your evaluation of efficacy.</i> <p><i>For example:</i></p> <p>Cochlear implants are moderately effective in managing and assisting individuals with sensorineural hearing loss.</p> <p>Cochlear implants can help people with severe or even complete hearing loss. They send electrical impulses directly to the cochlear nerve to be interpreted by the brain. This allows someone with severe conductive, sensorineural or mixed hearing loss to be treated.</p> <p>However, sound perception with a cochlear implant is not the same as natural hearing, e.g. pitch and timbre of speech are difficult to hear, isolating a voice in a crowd is difficult, and training is often needed to help the brain interpret sound signals.</p> <p>[Note: The cochlear implant will hopefully improve over time regarding some of these aspects. Nonetheless, a cochlear implant can significantly improve the hearing ability of someone with significant sensorineural hearing loss.]</p>
21.8	1	<p>a) • Filtration (of blood). • Reabsorption (of useful parts of the filtrate).</p> <p>b) Urine</p> <p>c) Water, salts and urea.</p> <p>d) <i>Multiple correct answers, including:</i></p> <ul style="list-style-type: none"> • Blood volume • Osmoregulation • Blood pressure • Oxygen concentration (by producing a hormone to increase red blood cell production) • Concentration of nitrogenous wastes in blood • Salt concentration in the blood

Chapter 21 [continued]

Section	Activity	Sample answers
21.8	3	<p><i>There are many possible causes for kidney failure, including:</i></p> <ul style="list-style-type: none"> • Other medical conditions, e.g. diabetes and high blood pressure (hypertension) increase your risk of kidney failure. • Some genetic conditions, e.g. polycystic kidney disease (PKD) is a genetic disease that causes cysts to develop within the kidneys that interfere with kidney function. • Traumatic injuries, e.g. kidney damage as an injury sustained in a car crash • Immune responses – some infectious diseases (e.g. HIV and hepatitis C), as well as some immune diseases (e.g. Lupus) increase the risk of glomerulonephritis. This involves inflammation of the glomerulus within the kidney's nephrons and can lead to kidney failure. • Medications and drugs – exposure to some substances can cause kidney failure as a side effect. • Urinary reflux – a problem involving the bladder valve malfunctioning, allowing urine to back flow into the kidney where it can cause scarring. • Reduced blood flow to the kidney, e.g. blockages in the renal artery.
	4	<p>Deaths from kidney failure are more frequent in males compared to in females. There was a general increase in the rates for both males and females from around 1980 to 2010. Around 2012, there was a significant decrease in rates for both genders.</p>
21.9	1	<ul style="list-style-type: none"> a) Kidney transplant b) No c) Haemodialysis d) The dialyser e) Heparin f) The air trap and air detector. g) Pressure monitors. h) Four to five hours. i) At least three times per week. j) It will have less urea and a different concentration of salts and water.

Chapter 21 [continued]

Section	Activity	Sample answers
21.9	2	<p>a) If the salts in the blood exceed the ideal amount, their concentration will be greater than dialysate, which has the ideal amount. This will mean there is a concentration gradient for salts to diffuse into the dialysate.</p> <p>b) If the dialysate is not fresh, urea will build up, preventing further diffusion of urea from the blood. Similarly, the salt concentration in it will change, preventing the correct balance of salts and water in the blood.</p> <p>c) Homeostasis of body temperature is essential. This ensures the patient's blood is at the right temperature for return to the body.</p> <p>d) <i>Benefits:</i></p> <ul style="list-style-type: none"> • Corrects water and salt concentrations in blood. • Removes nitrogenous wastes from blood. • Does not typically cause pain. • Helps to keep people with kidney failure alive. <p><i>Limitations:</i></p> <ul style="list-style-type: none"> • Very time consuming. • Risk of infection (at the site used for blood to enter/exit). • Many patients still die (within several years of beginning dialysis). <p>e) It is not a valid to use. The causes of kidney failure often involve other health conditions. So, patients may have died from unrelated causes to their kidney condition. Kidney failure is correlated with old age. This can lead to many health complications that could have caused death.</p>

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