Oxford Resources for IB

Biology – 2023 Edition

Answers

Topic D1 – Molecules

Page 559 Data-based questions: The Messelsohn–Stahl experiment

1. a. 1.717; **b.** half ^{14}N and half ^{15}N;

2. much at 1.710 and less at 1.717;

much with only ^{14}N and some with half ^{14}N and half ^{15}N;

with each round of replication less DNA has a ^{15}N strand from the original parent molecule;

3. a. after one generation all the DNA is 1.717;

showing that it is half ^{14}N and half ^{15}N;

because one strand is entirely conserved from the parent DNA and the other is entirely new;

b. two bands;

one at 1.710 and one at 1.724;

Page 566 Data-based questions: Analysis of DNA profiles using D1S80

1. smallest is at the bottom;

all are multiples of 123;

calculations (starting at top of page): 861bp, 738bp, 615bp, 492bp, 369bp, 246bp, 123bp;

2. Measurements will vary

Distance moved / mm	Ladder band size / bp
3.5	861
8	738
13	615
19	492
26	369
34	246
44	123

3. Measurements will vary

Individual 1: 25 mm, 28 mm

Individual 2: 17.5 mm, 36 mm

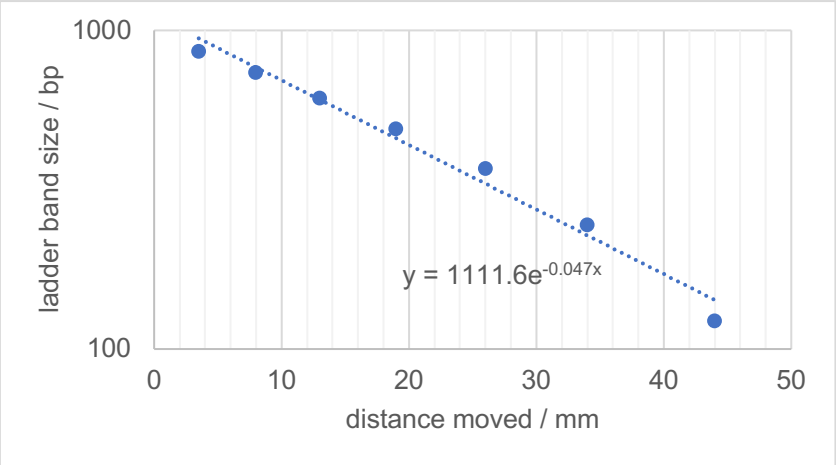
Individual 3: 14.5 mm, 29 mm

Individual 4: 11 mm, 18.5 mm

Individual 5: 12 mm, 32 mm

Individual 6: 17 mm, 18.5 mm

4. Standard curve using answer to question 2:



Calculations will vary depending on measurements.

Individual 1: 346 bp, 301 bp

Individual 2: 491 bp, 207 bp

Individual 3: 565 bp, 287 bp

Individual 4: 665 bp, 469 bp

Individual 5: 635 bp, 250 bp

Individual 6: 503 bp, 469 bp

5. Bands are multiples of 16;

Individual 1: 22 repeats, 19 repeats

Individual 2: 31 repeats, 15 repeats

Individual 3: 35 repeats, 18 repeats

Individual 4: 41 repeats, 29 repeats

Individual 5: 40 repeats, 16 repeats

Individual 6: 31 repeats, 29 repeats

6. run the separation for longer;

Page 570 Data-based questions: Discovery of Okazaki fragments

1. increasing numbers of Okazaki fragments over the first 30 seconds;

as they are produced but not yet linked up;

less after 60 seconds because DNA ligase has linked them up;

2. **a.** more radioactive fragments of all sizes at 30 seconds;

increase in ratio of larger fragments to smaller fragments at 30 seconds/2 peaks at 30 seconds versus one peak at 10 seconds;

b. two peaks suggests two different sizes of molecules predominate;

higher peak represents large number of small fragments/lagging strands;

smaller peak represents a number of longer fragments/leading strands;

3. If lagging strands are joined together by DNA ligase, then the number of initial small molecules would decrease and the number of larger molecules would increase. This is what is observed so the hypothesis is supported.

Page 584 Data-based questions: Determining an open reading frame

1. 64
2. 3/64
3. RF3

Page 591 Data-based questions: Proteasomes

1. Proteasomes identify damaged or unwanted proteins and tag them with molecules of ubiquitin so they are destroyed by specific cell enzymes.
2. small reduction after one week and (much) larger reduction after three weeks;

   the longer the treatment the larger the reduction / reduces oxygen consumption over time;
3. oxygen used in / needed for aerobic respiration;

   oxygen used at end of / to accept electrons from electron transport chain;

   respiration releases energy / produces ATP in cells;

   reject produces energy / produces energy in the form of ATP

   ATP production requires oxygen;
4. *One marking point corresponds to each of the three graphs in both pros and cons*

   might be safe because:

   does not affect heart cell survival (significantly) at concentrations below 20;

   effect on systolic area / on heart seems to be reversible;

   oxygen consumption does not drop much in the first week (of treatment);

   could be dangerous due to:

   reduced survival / death of non-tumor / cardiac muscle cells / non-specific;

   reduced volume / pressure of blood pumped by heart / more blood left in ventricles;

   reduced aerobic respiration / mitochondrial activity / damage to mitochondria;

   Do not award marks for answers that merely restate data from the graphs such as systolic area or oxygen consumption are reduced

Page 596 Data-based questions: *BRCA1* mutations

1. frameshift mutations change many/multiple amino acids in the polypeptide produced;

   protein structure much altered;

   protein unlikely to be able to carry out its function;

   tumour suppression impaired;

   errors in DNA that will result in oncogenic mutations not corrected;

   breast cancer frequently develops;

2. a. $\frac{11}{54} \times 100\% = 20\%$;

b. nonsense mutation is a change to a stop codon;

truncated polypeptide produced;

gene product of *BRCA1* gene unlikely to function;

increased chance of being a patient with breast cancer;

3. a. eight patients in each group;

much more diversity in mutations in African Americans;

only frameshift mutations in Ashkenazi Jewish;

frameshift, mis-sense, nonsense and splice mutations in African Americans;

b. much more genetic diversity among African Americans;

more diverse origins;

more different SNPs are in the African American gene pool;

endogamy in Ashkenazi Jewish population/only marriages within the religion reduces genetic diversity;

Page 605 Data-based questions: Investigation of susceptibility to malaria infection of different haemoglobin types

1. a. 0.85

b. 0.62

c. 0.35

d. 1.4

2. both have lower susceptibility to AA;

AE is less susceptible than EE;

3. homozygotes of A and E allele both more susceptible than the heterozygote;

heterozygotes more likely to survive malaria to reproductive age;

preserving both alleles'

Page 607 End of chapter questions

1. a. peptide bond

b. mRNA

c. tRNA leaving from E-site;

tRNA-polypeptide chain complex shifting to P-site and new tRNA entering the A-site

d. efficient use of resources;

one mRNA translated multiple times;

can be a form of regulation of the rate of gene expression;

2. a. DNA damage increases with depth to 9 m/maximum at 9 m/little change between 0 m and 9 m;

below 9 m DNA damage decreases;

b. *Compare requires similarities only*

both have highest damage at 9 m;

both follow a pattern of increase to 9 m and then a decrease;

c. more scattering of light / reflection / less UV light penetrates rough surface;

more turbidity / less transparent / sediment stirred up on windy days;

windy days tend to be more cloudy;

d. cancer is due to disruptions in the regulation of cell division;

mutations that cause cancer can be inherited or acquired;

acquired mutations are due to DNA damage;

DNA damage could occurs in regulator regions that would otherwise contribute to the regulation of cell division;

Topic D2 – Cells

Page 620 Data-based questions: Identifying phases of mitosis

1. a. Zi, Ziii and Zv;

b. Zii is in anaphase;

Ziv is also in anaphase;

2. Vi metaphase;

Vii anaphase;

Wi interphase;

Wii prophase;

Wiii telophase;

Xi telophase;

Xiii anaphase;

3. a. Yii is in prophase;

b. Yiii is in metaphase;

Yv is in metaphase (because the chromosomes are still inside a nucleus);

4. Wiii;

Xi;

5. unequal cytokinesis/cell division; differentiation for a specialized function; nucleoli;

positioned inside the nucleus / cell is in interphase and nucleoli disappear during mitosis;

6. ribosomes produce proteins;

7. cell Wi is in interphase so makes lots of protein;

cells in a root tip are growing so need more ribosomes and other organelles;

Page 623 Data-based questions: Life cycles

1. both have haploid sperm and egg;

both have an *n* stage;

both have a 2*n* stage;

both have mitosis, meiosis and fertilization;

both have a zygote stage;

2. in humans, the zygote gives rise to either a male or female individual but in moss, the zygote gives rise to a sporophyte;

in moss, the diploid sporophyte gives rise to spores whereas diploid humans give rise to gametes;

eggs and sperm created by mitosis in moss but meiosis in humans;

moss plant can give rise to male or female, but separate genders create gametes in humans;

in moss, there is a gametophyte and a sporophyte, but not in humans;

meiosis gives rise to gametes in humans, but to spores in moss;

Page 624 Data-based questions: Parental age and non-disjunction

1. limited change in incidence until mid-30s;

exponential increase after mid-30s;

2. **a.** 1% ± 0.5%;

b. 1.7 minus 1.0; 0.7%;

3. chromosome 21 is one of the smallest of the human chromosomes;

other trisomies / extra other chromosomes have more serious effects;

causing death of the zygote / embryo / fetus before birth;

missing chromosomes / chromosome mutations also too harmful for the individual to survive;

4. increased risk of chromosome abnormalities;

but low risk before age of 40;

greater parental resources to look after children;

less overpopulation of the world with later parenthood;

Page 630 Data-based questions: DNA content per nucleus

1. group 1 are in G_1 or mitosis after cytokinesis;

II are in S phase;

III are in G_2 or mitosis before cytokinesis;

2. **a.** 14 pg;

b. 7 pg;

3. **a.** 46 as this is the normal number in humans;

b. 46 in group I;

46 in group II because DNA replication does not increase the chromosome number;

4. 3 pg because they are haploid so have half as much (as a diploid cell in G_1);

   half the sperm cells will have slightly less DNA than eggs or the other sperm because they have a Y chromosome instead of an X chromosome;

Page 635 Data-based questions: Cell proliferation in hepatocellular carcinoma

Answers will depend on the variables selected.

Page 635 Data-based questions: The principles of chemotherapy

1. chemotherapy results in a decrease in the number of both cell types;
2. both cell types recover in number;
3. normal cells recover faster / at a higher rate;
4. the destruction of normal cells could result in non-cancer tissue damage;

   example of tissue damage and impact: destruction of immune cells could result in an increased rate of infection;

Page 641 Data-based questions: Changes in methylation pattern with age in identical twins

1. green mixes with red to produce yellow;

   if both chromosomes are methylated in the same places, green will always mix with red to produce yellow;
2. all show differences between the two twins with chromosomes 1 and 17 showing some similarities;
3. chromosome 3 has the least yellow;
4. differences in methylation represent differences in regulation of gene expression;

   twins exposed to different conditions that affect gene expression resulting in methylation at different locations;
5. as they grow from 3 years old to 50 years old, they will become different from one another in those areas where gene expression is influenced by environmental factors;

Page 643 Data-based questions: Epigenic inheritance

1. late pregnancy;
2. increase of 3.3%;
3. mother with long-term effects of famine / affects child's development / famine over but nutrition remains poor;
4. exposure to famine *in utero* correlated with high blood glucose as an adult;

   especially in late pregnancy;

   possible epigenetic effect / impact on gene expression later in life;

   could be correlation rather than cause and effect;

Page 644 Data-based questions: Phenotypic plasticity

1. lake shells are longer than river shells;
2. river shells have wider apertures;
3. DNA methylation affects gene expression / tends to inhibit gene expression;

   differences in methylation suggest different genes are being expressed in the different locations;
4. phenotypic differences are due to different genes being expressed in the different locations;

   differences are not due to different genotypes but different genes being expressed;

Page 646 Data-based questions: Identical twin studies

1. approximately 40%;
2. identical twins have the same combination of paternal and maternal chromosomes;

   their genotypes are the same for all genes;

   having a higher probability of both having the disease than siblings / fraternal twins suggests a genetic component to the condition;
3. height has the highest contribution coming from genetics, but not entirely;

   there is still an environmental component;

   rheumatoid arthritis has lowest genetic contribution, but still some component;

   diabetes has significant increase in probability with genetics, but still relatively low overall probability;

   alcoholism has a genetic component;

Page 651 Data-based questions: Solutes in fruits

1. sucrose concentrations much higher in plums than cherries or grapes;

   fructose most concentrated sugar only in grapes/fructose least concentrated in plums;

   glucose present most or second most concentrated solute in all fruits;

   sweet cherries have the highest overall sugar concentration;
2. sweet cherries have higher sugar concentration than sour cherries;

   sour cherries have higher acid concentrations than sweet cherries;
3. **a.** water passes by osmosis from the glucose solution to the sweet cherry tissue by osmosis;

   water passes from the sour cherry tissue to the glucose solution by osmosis;

   sweet cherry tissue gains mass and sour cherry loses mass;

   b. plum cells lose water to the grape juice by osmosis;

   until their cytoplasm becomes isotonic with the grape juice;

Page 652 Data-based questions: Osmosis in plant tissues

1. **a.** it moved into the tissues;

   b. it moved out of the tissues;

2. the cactus had the lowest concentration;

   where the graph crosses the *x*-axis is isotonic;

   lowest isotonic value seen for the cactus;

3. cactus tissue might act as a water store, so has low solute concentration;

   pine kernel might have dried out to become dormant, so has a high solute concentration;

   pine / butternut squash / sweet potato might be adapted to habitat with higher solute concentrations in the soil;

   butternut squash / sweet potato / pine kernel might contain large quantities of sugar / stored foods so have a high solute concentration;

4. the starting masses might have been different in different tissue samples;

   percentage change is a better measure of relative change;

Page 656 Data-based questions: Analysing osometer results

1. solute concentration higher inside the bag than in the beaker;

   so water enters the bag by osmosis;

   so volume of solution increases (and height in tube increases);

2. **a.** increases in height continue;

      but get smaller and smaller;

      until there is equilibrium/no more increase/no more change;

   b. solute concentration still higher in the bag so water continues to move from beaker to bag;

      solution in bag is diluted by water entry so rate of entry gets less;

      pressure rises in bag as solution rises in tube;

      pressure eventually so high that there is no more net water movement from beaker to bag;

3. **a.** slower rises in height/less rise in height per minute;

      rises in height stop sooner;

      because difference in concentration of solutes is less;

      because less pressure is needed to prevent net movement of water;

   b. height of solution in tube drops;

      because water moves from the bag to the beaker;

      because solute concentration in the beaker is higher than in the bag;

      both sucrose and sodium chloride attract water molecules when dissolved;

Page 660 Data-based questions: Water potentials in plant cells

1. a. −1 MPa; **b.** −10 MPa; **c.** −6 MPa;

d. when the pressure potential is never more positive than the solute potential is negative; because soil/external water potential is not normally higher than in cells and water is lost from cells with a higher water potential than the soil/exterior;

2. a. −0.05 MPa; **b.** −0.65 MPa;

c. water moves into the xylem from surrounding cells;

despite it being hypotonic;

water drawn into xylem by very low/negative pressure potentials;

water does not always move from a hypotonic to a hypertonic solution;

3. a. more negative solute potential in root cells than soil;

due to active transport of mineral ions into the root;

so water potential is lower in the root cells; so water moves from the soil to the root cells;

causing an increase in pressure;

atmospheric pressure in the soil;

b. water potential in xylem vessels is lower than in surrounding root cells;

so water moves into the xylem;

generating flow;

lower water potential in xylem is due to higher pressure in surrounding cells;

and to more negative solute potential;

solutes must be pumped into the xylem vessels by active transport;

implying that energy is used to maintain xylem flow at night when transpiration does not cause negative pressure potentials;

4. a. root Ψ_w = −0.44 MPa;

leaf base Ψ_p = +0.35 MPa;

leaf tip Ψ_s = −1.29 MPa;

b. leaf tip cells have a lower water potential;

due to higher solute concentration/more negative solute potential;

water moves from higher to lower water potential;

pressure higher in leaf tip cells but difference in solute potential counteracts this;

c. leaf base cells have a lower water potential than leaf tip cells so more water moves to them from the root than to the leaf tip;

lower water potential of leaf tip cells is due to lower hydrostatic pressure not higher solute concentration;

cell walls thinner/cellulose microfibrils in walls looser so less pressure build-up;

looser microfibrils allow cells in the leaf base to expand;

walls of cells in leaf tip prevent expansion so allowing higher pressures to develop;

Page 663 End of chapter questions

1. a. nerve cells did not divide;

the control cells grew in number the most;

the endodermal cells grew in number but less than control cells;

b. there is an inverse relationship between degree of differentiation and population growth / less growth with more differentiation;

c. for all three types, the number of cells in G1 is similar;

far more in S phase in control cells / similar number in S phase for endodermal and nerve cells;

more / same in G2 for endodermal and nerve cells / low number in G2 for control;

d. endodermal cells and differentiated nerve cells have relatively low levels of DNA synthesis / replication;

the lower the level of population growth, the lower the number in S phase;

e. two daughter cells

2.

Diagram	Stage of mitosis
A	early anaphase
B	prophase
C	telophase
D	metaphase

Topic D3 – Organisms

Page 672 Data-based questions: The female athlete triad

1. a. the more menstrual cycles, the higher the bone mineral density;

significant increase in bone density once the number of cycles surpasses 10;

effect on bone density is not uniform across the bone;

b. as few as 1–3 has clear effect on entire bone but 4–10 has a different effect depending on the part of the bone;

neck of femur has lower density when number is between 4–10;

trochanter has higher density when number is between 11–13;

lowest density reached in neck/highest density reached in trochanter;

both show the relationship that the more menstrual cycles, the higher the bone mineral density;

2. a. may have better diets;

may have more moderate running regimes;

b. might be caused by caused by insufficient nutrient intake;

might be caused by low estradiol levels;

older runners might be over-represented in this category;

high energy consumption might forestall bone maintenance;

3. **a.** preserving resources for demanding exercise regime;

   reduced estradiol impacts uterine and ovarian hormone cycles;

   b. reduced appetite/exercise regime is part of weight loss strategy;

Page 674 Data-based questions: Age and IVF

1. success rate increases as age of mother increases;

   success rate much lower above age 39;

   success rates slightly lower below 30 than 30–34;

2. success rates increase as more embryos are transferred;

   but rate with two/three is not double/triple rate with one;

   rate with three embryos only slightly different from rate with two;

3. restricting the number of embryos transferred reduces chance of multiple birth;

   multiple births increase the health risks for mother/child(children);

   restricting number of embryos to two would prevent (almost all) triplets;

   older mothers at less risk of multiple births so more embryos could be transferred;

Page 676 Data-based questions: Animal and wind pollination

1. animal pollination is more common;

2. **a.** higher percentage of animal-pollinated species with higher temperatures;

   b. higher temperatures nearer the equator/at lower latitudes;

   more animals/animal species with higher temperature;

   animals/insects more active at higher temperatures;

   plants have more energy for nectar production at higher temperatures;

   more diversity of plant species at higher temperatures/lower latitudes so wind pollination less successful;

   less wind in lower latitudes/nearer the equator;

   denser vegetation at higher temperature so less penetration by wind;

   evergreen plants with higher temperatures so no time of year when leafless trees can pollinate with wind;

3. low population densities of plants;

   pollen unlikely to be blown from anther to stigma by wind;

   insects travel from flower to flower so are more likely to transfer pollen;

   relatively few pollinators so flowers have to be conspicuous to advertise;

Page 680 Data-based questions: Pollination in Manchurian walnut trees

1. all the trees have separate maturation times for male and female flowers;

some trees are protogynous and some are protandrous;

there is usually a gap between male and female flowers being mature;

stigmata are usually receptive for longer than the period of pollen release;

there are always some receptive stigmata when pollen is being released;

stigma maturation varies more between trees than pollen release;

2. earlier flowering season in 2003;

individual trees remain either protogynous or protandrous;

3. reduces the chance of self-pollination/self-fertilization;

reduces the chance of inbreeding;

reduces the chance of genetic diseases/less chance of being homozygous for rare recessive alleles;

increases the chance of hybrid vigour/reduces the chance of inbreeding depression;

4. avoids stigmata being mature when no pollen is being dispersed;

avoids pollen being spread when there are no mature stigmata;

Page 704 Data-based questions: Deducing genotypes from pedigree charts

1. it is recessive as unaffected parents in generation I produce affected children;

2. **a.** 100% that they will be homozygous recessive;

b. 0%;

c. 0%;

3. **a** *Dd*; the mother is *dd*;

b. *Dd* or *DD*; most likely *DD* as condition is rare and person is marrying into family with history of disease;

4. cystic fibrosis; sickle cell anemia;

other examples of autosomal genetic disease caused by a recessive allele;

Page 713 Data-based questions: Coat colour in the house mouse

1. 198 grey: 72 albino; 2.75 grey: 1 albino;

2. albino is recessive;

the presence of the albino is masked by the grey allele;

in a cross of heterozygotes, approximately 25% are albino;

3. *GG* / homozygous dominant is grey;

Gg / heterozygous is grey;

gg / homozygous recessive is albino;

4. the parental phenotypes are grey and albino;

the parental genotypes are *GG and gg*

the alleles in the gametes are *G* and *g*;

the F_1 phenotypes are all grey;

the F_1 genotypes are all *Gg*;

	G	***G***
g	*Gg*	*Gg*
g	*Gg*	*gg*

the alleles in all F_1 gametes are *G* and *g*;

the F_2 phenotypes are grey and albino in a ratio of approximately 3 : 1;

the F_2 genotypes are *GG* + *Gg : gg*; in a ratio of approximately 3 : 1;

	G	***g***
G	*GG*	*Gg*
g	*Gg*	*gg*

5. white fur and red eyes due to lack of the same pigment / melanin; due to a single mutation in gene for an enzyme needed to make the pigment.

Page 719 Data-based questions: Using the chi-squared test

1. and 2.

	White crested	**Non-white, non-crested**	**Non-white crested**	**White non-crested**	**Total**
Observed	337	337	34	46	754
Predicted	188.5	188.5	188.5	188.5	754

3. 3 degrees of freedom expected;

4. critical value for 3df = 7.815;

5. X^2 = 468.3;

6. H_o the traits are not linked and differences between observed and predicted are due to sampling error;

Page 720 Data-based questions: Flower colour and stem length in peas

1. *EEhh* × *eehh* → *Eehh;*

eeHH × *eehh* → *eeHh;*

2. *Eh* and *eh*, *eH* and *eh;*

3. *EeHh*, *Eehh*, *eeHh* and *eehh;*

4. 1 : 1 : 1 : 1

5. H_o the ratio is 1 : 1 : 1 : 1 because the traits are not linked and differences between observed and predicted are due to sampling error;

   H_1 the traits are linked and differences between observed and predicted are not due to sampling error;

   frequencies predicted by a 1 : 1 : 1 : 1 ratio are all 41.5;

   3 degrees of freedom;

   critical value for 3df = 7.815;

   X^2 = 0.73 + 0.30 + 0.05 + 0.02 = 1.08 (calculated by working to three decimal places and then rounding);

   this is outside the critical region;

   we do not reject H_0;

   there is no significant difference between the observed frequencies and a 1 : 1 : 1 : 1 ratio;

   this indicates that the genes have assorted independently and must be unlinked on different chromosomes;

6. Red tall are recombinants because that phenotype wasn't seen in the P or F_1 generations.

   Arguably white dwarfs are also recombinants because they did not appear in the F_1 generation.

Page 725 Data-based questions: The glucose tolerance test

1. In the person with diabetes:
   - **a.** higher concentration of glucose at time zero;
   - **b.** longer time to return to baseline (hasn't occurred after 5 hours);
   - **c.** much higher maximum glucose;
   - **d.** delay in time before glucose begins to fall;
2. Lower than normal in a fasting test as impaired insulin action may not maintain blood glucose levels.

Page 732 Data-based questions: Ultrafiltration of charged and uncharged dextrans

1. the larger the particle size, the lower the permeability to them of the filter unit;
2. **a.** all show a decline in permeability with an increase in size;

   neutral dextran shows the most direct relationship;

   dextran sulfate permeability declines most rapidly with an increase in size;

   DEAE permeability declines most slowly with an increase in particle size;

   b. large particles of any type cannot pass easily through the membrane;

   electric charge has an impact on ultrafiltration;

   with negatively charged particles decreasing ultrafiltration and positively charged particles increasing the rate of ultrafiltration;

3. regardless of charge, particles as large as 4.4 nm do not end up in the filtrate;

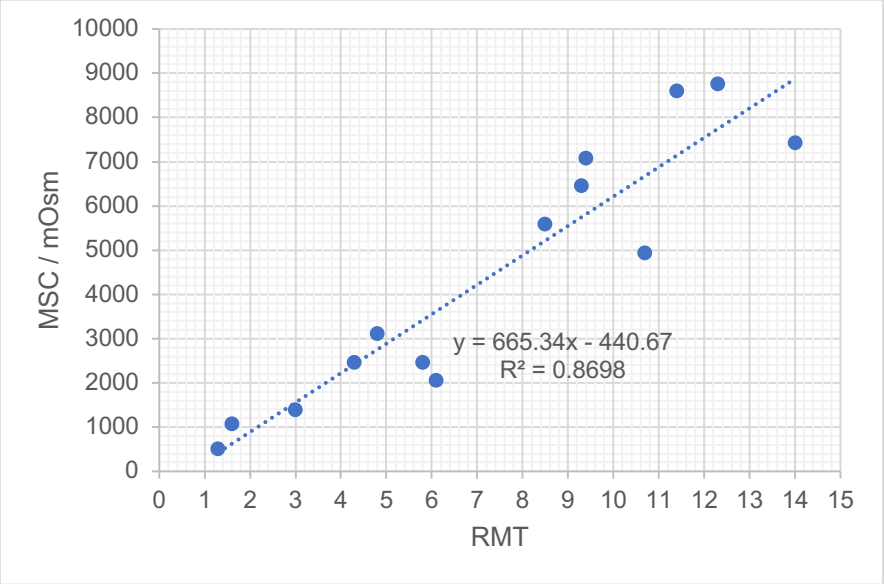
   the presence of such particles in the urine indicates kidney function disability because they have been able to pass through the glomerulus when they normally would not pass through;

Page 734 Data-based questions: Medulla thickness and urine concentration

1. the drier the habitat, the more concentrated the urine;

some variation evident;

2.



3. a. the higher the RMT, the higher the MSC produced;

b. the length of the loop of Henlé determines the solute concentration established in the medulla;

the higher the RMT, the longer the loops of Henlé;

Page 735 Data-based questions: ADH release and feelings of thirst

1. a 5.3 (±0.3) pmol dm^{-3};

b. both show a positive correlation;

both have no data below 280 mOsmol kg^{-1} / above 310 mOsmol kg^{-1};

steadier increase in thirst whereas greater increases in ADH concentration as plasma solute concentration rises;

2. after drinking water, blood plasma / solute concentration decreases;

plasma ADH concentration decreases;

osmoreceptors in the hypothalamus monitor blood solute / blood plasma concentration; impulses passed to ADH neurosecretory cells to reduce / limit release of ADH;

drop in ADH decreases the effect of this hormone on the kidneys;

blood solute concentration returns to normal;

3. vomiting / diarrhea / blood loss;

increased salt intake;

drinking alcohol / coffee;

taking certain drugs / morphine / nicotine / barbiturates;

excess sweating / lack of water intake;

diabetes as it increases glucose in blood;

Page 737 Data-based questions: Blood supply in piglets

1. change is final minus initial; percentage change is change divided by initial × 100;

2. **a.** less muscle contraction;

b. reduced ventilation due to lower requirement for gas exchange;

less cell respiration;

greater decrease with intercostal muscles as they are only used for forced expiration / large tidal flows;

c. less epinephrine secretion;

d. smaller cardiac output so less requirement for glucose and oxygen in cardiac muscle;

e. increased removal of toxins from brain tissue;

3. piglets do not reduce urine production at night;

piglets urinate during sleep;

piglets are not 'house-trained';

Page 739 End of chapter questions

1. **a.** June;

b. *L. triangularis* in July;

c. because there are no competitors;

d. approximately 0.9 m;

e. (1.5 × IQR) = (1.5 × 0.9) = 1.35;

Q3 is 1.45 so outlier out be above 1.45 + 1.35 = 2.2;

2. **a**. there are seven linkage groups;

b. **i.** round / wrinkled seed and yellow/green cotyledons;

ii. yellow / green cotyledons and purple/white flowers;

c P: 1 FFGG x ffgg

F1: FfGg x FfGg

F2: 9 full green, 3 full yellow, 3 constricted green, 1 constricted yellow

d. when they are technically linked but far apart on the chromosome, the rate of crossing over is so high that they appear to be unlinked;

the greater the distance between two linked traits, the higher the frequency of crossing over between them;

Topic D4 – Ecosystems

Page 746 Data-based questions: Hunting as a selection pressure for smaller horns

1. diet / environment / fights / mechanical damage / age;

2. six years (units required);

3. **a.** the larger the horn length (index) the lower the longevity / vice versa / inverse proportion / negative correlation

b. males with large horns are killed by hunters;

males with large horns are killed in fights;

horns more likely to be broken with age;

4. **a.** males with short horns survive longer / vice versa;

few males with big horns survive beyond six years / to breed;

males with shorter horns have more offspring / vice versa;

genes/traits for short horns are passed on to offspring / vice versa;

killing (including by hunting) of large horn males causes (natural) selection;

b. reduce hunting / stop selling hunting licences;
allow hunting of small horned sheep only;

alter values in regard to hunting;

Page 753 Data-based questions: Stabilizing selection

1. any value from 3.25 kg to 3.49 kg;

2. any value from 3.50 kg to 3.74 kg;

3. initially as birth mass increases up to 3.5 kg, survival increases, hence mortality decreases;

as birth mass further increases beyond 3.5 kg, survival decreases and mortality increases;

further from mode, the higher the mortality, the highest survival and lowest mortality nearest to mode value;

4. birth mass shows variation;

selection against very low / very high birth weights;

Page 756 Data-based questions: Domestication of corn

1. $\frac{170-14}{14}\times 100\%$

= 1114% increase in length;

2. $\frac{4100-150}{150}\times 100\%$

= 2633% increase in yield;

3. seed texture;

   sweetness of seeds / kernels;

   texture / starchiness of seeds / kernels;

   number of seeds / kernels per cob;

   colour of seeds / kernels;

   disease resistance;

   frost hardiness; tolerance of drought;

4. loss of genetic diversity;

   less variation;

   purebred varieties developed;

   loss of hybrid vigour;

   inbreeding;

Page 764 Data-based questions: Environmental impacts of human diets

1. **a.** 2 kg

   b. 8.8 kg

2. chickens use energy to maintain constant body temperature but salmon do not;

3. salmon most sustainable as food conversion ratio is lowest;

   but wild-harvested fish used to feed salmon;

   beef sustainable because they are primary consumers so less energy is lost along the food chain;

4. animals are at a later stage in the food chain;

   energy losses between trophic levels;

   animals use energy to move;

5. **a.** emissions during the growth of cattle;

   dairy cattle then produce milk for years but beef cattle are slaughtered and have to be replaced;

   b. lamb takes longer to grow than poultry;

   sheep emit methane and poultry do not;

   c. rice is grown in flooded paddies which emit methane but peas are not;

   peas have bacteria to fix nitrogen but chemical fertilizer is used on rice crops;

Page 767 Data-based questions: Biomagnification

1. 3.5;

2. because the fish participates in multiple food chains and occupies different trophic levels in the different food chains;

3. each trophic level results in a 10-fold increase in concentration;

4. in the marine fish food web;

5. the concentration is the same in both trophic levels;

6. the toxin might store in tissues only found in mammals and not in fish;

   in both food webs, the pattern for salmon, cod, sculpin, etc. is the same;

   the processes might be different (bioaccumulation vs biomagnification);

Page 769 Data-based questions: Laysan albatrosses

1. mistaken for food;

   adults feeding plastic to chicks;

   skimming of ocean surface for food;

2. Kure receives more debris than Oahu;

   ocean currents concentrate plastic debris in certain locations;

   more exposure to human population in the environment of Kure;

3. (macro) plastics blown/carried/washed from land sources into the ocean;

   degraded over time;

   to form microplastic fragments;

4. bioaccumulation occurs when egestion or breakdown of a pollutant or toxin occurs at a rate which is lower than its ingestion;

   toxins / organic molecules can adsorb to the surface of microplastics and bioaccumulate in organisms at lower trophic levels;

   biomagnification occurs when toxins/pollutants ingested by organisms at lower trophic levels end up being concentrated by feeding in higher trophic levels;

Page 773 Data-based questions: Succession in Glacier Bay

1. **a.** mean stem diameter increases with time, though data is highly variable;

   b. increased survival of trees;

   they increase in diameter as they age;

2. **a.** the number of species increases with time;

   sharp increase after 44 years;

   b. evenness improves with time;

3. **a.** organic content increases with spruce;

   moisture content increases with spruce;

   nitrogen increases with spruce;

   bulk density decreases with spruce (meaning greater aeration of soil / soil becomes more porous);

   pH decreases with spruce;

   conditions are similar for the other three species;

   b. The stage where the greatest changes in soil properties is observed is from the alder stage to the spruce stage;

   this is the case for all five variables;

Pages 787 Data-based questions: Phenology

1. **a.** 1990;

   b. 1970;

2. **a.** the higher the temperature, the earlier the opening of the chestnut leaves;

   b. over the final 10 year period, highest average temperatures occured; pervious pattern appeared to be cyclical; supports claim of global warming;

Page 788 Data-based questions: Spruce bark beetle, climate and tree stress

1. **a.** the late 1960s and the 1990s;

   b. Starting with a low annual mean temperature in the early 1970s, then an increase in the late 1970s that is largely maintained (with some variation) through to 2000.

   c. i. the number of years with an infestation is a longer stretch in the 1990s; the number of affected hectares is much higher in the 1990s;

   ii. increase in the number of cycles in one season; population explosion with limited predation due to global warming;

   d. data suggests increased destruction of spruce trees in future; warmer temperatures will reduce life cycle to one year / increase reproduction rates; rates of destruction may remain stable / decrease; if there is an increase in predation of the spruce beetle;

Page 789 Data-based questions: Evolution related to climate change

1. **a. i.** decreasing

   ii. generally strongly increasing

   b. milder winters with higher average temperatures (perhaps caused by climate change), so less snowfall

2. The likelihood of an individual passing on its genes to the next generation.

3. Owls with brown feathers would have been more obvious to predators in years of greater snowfall and are now less obvious than owls with grey feathers, so more brown owls survive to pass on their genes.

Page 790 Data-based questions: Evolution due to climate change

1. 28%

2. Decrease in percentage difference between melanic and non-melanic forms between coastal and inland sites.

3. The melanic form, as black surfaces reflect less light energy, so absorb more.

Page 794 End of chapter questions

1. a. as latitude increases so does wing size / direct relationship / positive correlation;

b. *Compare requires similarities only*

all show an increase in wing size with latitude;

Some differences

at higher latitudes / above 45°, European species have larger wings than American species / largest wing sizes seen in European flies;

European flies show more variation than American flies (steeper curve);

at lower latitudes / below 45°, North American flies have larger wings than European species;

South American flies have smaller wing size than European / N. American flies;

c. American species show less variation because they have had less time to diverge / evolve;

size of American flies closer to that of flies recently introduced / founder effect / European founder population from low latitudes;

American flies exposed to different selective pressures;

d. isolated populations diverge (genetically) / separation of gene pools;

may become a new species / allopatric speciation;

wing size will follow same trend as in Europe as population spreads (to higher latitudes because larger size favoured by higher latitudes/colder climate);

wing size may stay small due to smaller gene pool / different climate;

2. a. March

b. (at) 140 m (of water depth) because there is no photosynthesis (except slight in June and October);

c. increased light penetration due to decrease in phytoplankton numbers / cloudiness;

(as the summer season approached) the Sun would be directly overhead making deeper light penetration probable;

d. *Compare requires similarities only*

Levels of productivity in same / similar order vs depth in both months;

Some differences

there is greater total production in March than in September;

the water at 100 m is relatively more productive in September than in March / the water at 100 m is unproductive in March, but is productive in September;

total production in March is approximately 28 to 29 mg m^{-3} day^{-1} whereas in September it is approximately 8 mg m^{-3} day^{-1};

the upper 40 m have their highest productivity in March and their lowest productivity in September;

3. a. turkeys: 33 / 32.6 / 32.56%

egg laying hens: 0 %

b. *Compare requires similarities only*

both have approximately same percentage/number of *E. coli* resistant to 1 or 3 antibiotics;

Some differences

none of the egg laying hens have bacteria resistant to 5 or more antibiotics while (10) chickens have bacteria resistant to 5 or more antibiotics;

13 / 65% of the egg laying hens have no resistant bacteria while 9 / 20% of the chickens have no resistant bacteria;

egg laying hens have less incidence of antibiotic-resistant bacteria than chickens;

c. hypothesis supported for poultry raised for meat but not for egg-laying;

turkeys and chickens always have bacteria resistant to more antibiotics than egg laying hens;

antibiotic-resistant bacteria are still found in egg laying hens even though antibiotics are rarely given;

antibiotic-resistant strains (of bacteria) may have arisen by other means / other than by poultry being given oral antibiotics;

d. from fecal matter to handling the chickens / by accidental hand-to-mouth contact / contaminated dust / eating raw meat;

4. a. 0.3 mmol dm^{-3}

b. *Compare requires only similarities*

at higher concentrations / above 0.03 both decrease;

Some differences

at low concentrations / below 0.03 growth increases in *A. lesbiacum* but decreases in *A. monta*num;

biomass production by *A. montanum* reaches zero but in *A. lesbiacum* does not;

A. lesbiacum grows better than *A. montanum* at all concentrations of nickel;

c. to ensure a known / constant nickel concentration / soil nickel concentration is variable;

because soil may already contain nickel (affecting overall concentration);

other metals / ions / nutrients / substances in the soil might vary / affect growth;

nickel may bind to soil and not be available;

to ensure that nickel concentration is the only variable;

d. 0.6% / 100%;

e. *Compare requires only similarities*

no significant difference between roots at low concentrations;

Some differences

A. lesbiacum roots have a higher nickel % than *A. montanum* roots;

A lesbiacum shoots have a much higher nickel percentage than *A. montanum* shoots;

A. lesbiacum shoots contain more than roots but reverse for *A. montanum*;

f. *A. lesbiacum* (roots) absorb more nickel than *A. montanum*;

membranes more permeable / pumps / channels;

faster transport of nickel in *A. lesbiacum* than *A. montanum*;

from roots to shoots / up the plant;

A. lesbiacum stores nickel in its shoots;

A. montanum stores nickel in its roots;

g. *A. lesbiacum* would be most useful;

A lesbiacum grows better in high / all nickel concentrations;

growth of *A. lesbiacum* is stimulated by moderate concentrations;

A. lesbiacum accumulates higher nickel percentages;

shoots of *A. lesbiacum* containing nickel could be removed;

5. a. 146 – 117 = 29 (±2) kg

b. weaning mass decreases during sardine regime (1975 to 1998) and increases during anchovy regime (1998 to 2004);

c. colder water (may) lead to more anchovies;

colder temperature waters lead to more successful foraging by female seals /increase weaning mass with anchovy regimes;

before 1985, sardine weaning mass is higher than at any other time;

sardines come with warmer water / before 1985 warmer waters (may have) led to more successful foraging by female seals;

inconclusive set of data / anchovy fat content may be higher thus foraging success has less impact;

anchovies still present in large numbers at the beginning of the sardine regime;

other foods available / other factors may influence decline;

d. weaning mass declines during a sardine regime;

sardine regime is favoured by warmer water;

global warming may increase proportion of time of sardine regime;

current changes due to climate change might decrease upwelling of nutrients;

leading to reduced weaning mass;