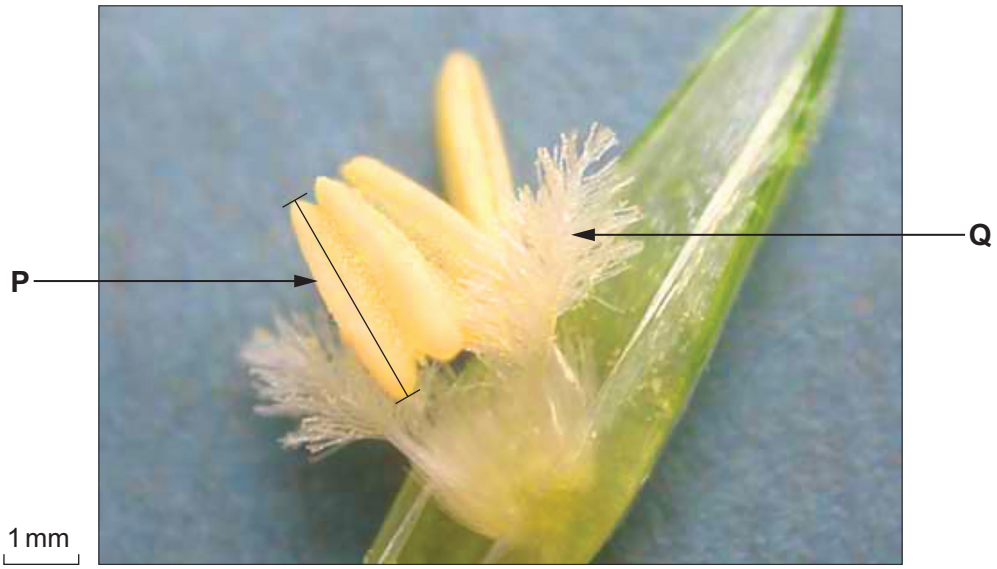
GCE Biology

S21-A400U20-1

Assessment Resource 11

Continuity of Life Resource B

1. *(a)* The photograph below shows a flower of the wheat plant, *Triticum aestivum*.



(i) Name the parts labelled **P** and **Q**. [1]

P .....

Q .....

(ii) Calculate the actual length of structure **P**. [2]

Size = ... mm

(iii) Describe **two** features of the flower shown in the photograph which suggest it is wind pollinated. [1]

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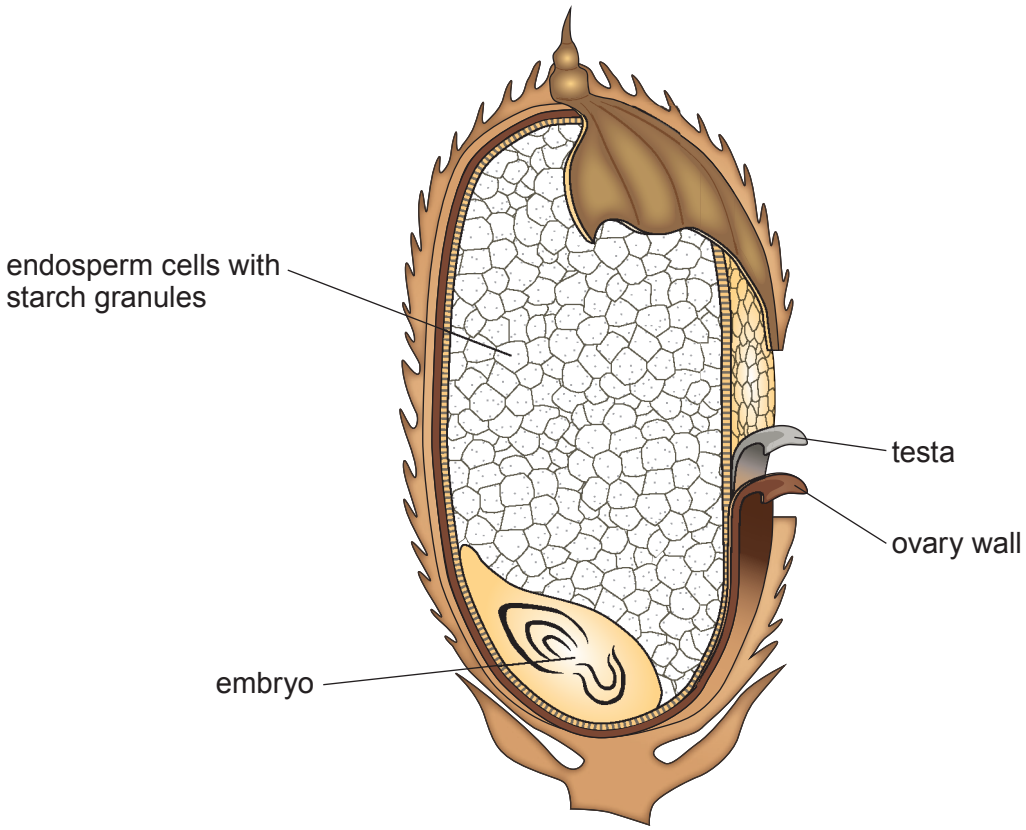
(b) The diagram below shows a wheat grain.



(i) Use information shown in the diagram to explain why the grain is more correctly described as a fruit rather than a seed. [2]

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(ii) Explain why the events taking place in the embryo sac of a wheat flower are described as a double fertilisation. [2]

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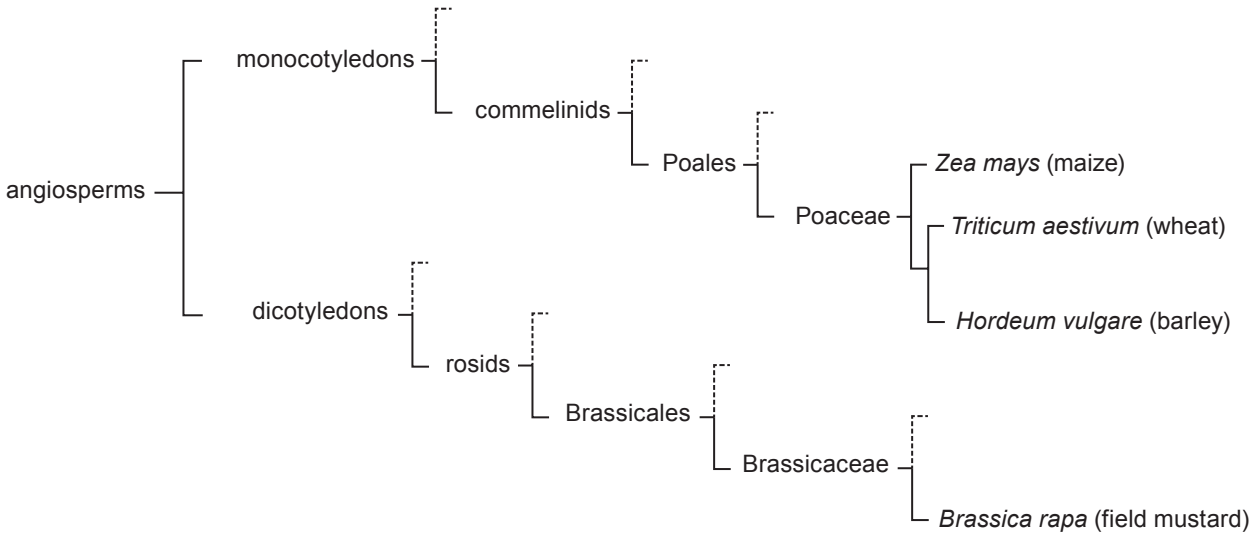
(c) The photograph below shows a flower of the field mustard plant, *Brassica rapa*.

Diagram **1** below shows the classification of wheat and field mustard and their evolutionary relationship.

Diagram 1



Each branch on the diagram represents a clade, i.e. an ancestor together with all its descendants.

(i) **Mark with an X**, the position on the diagram where wheat and field mustard share a common ancestor. [1]

(ii) In modern plant classification systems hierarchical groups like Divisions and Classes have been replaced with unranked clades, but orders and families have been retained and have names ending in **~ ales** and **~ aceae** respectively.

Use the diagram opposite to complete the classification of field mustard and wheat. [2]

Kingdom:	Plantae	Plantae
(unranked):	angiosperms	angiosperms
(unranked):	.....	monocotyledons
(unranked):	Rosids	.....
Order:	.....	Poales
Family:	Brassicaceae	.....
Genus:	*Brassica*	*Triticum*
Species:	***B. rapa***	***T. aestivum***

(iii) Using the information given and your own knowledge, describe how the seed of field mustard differs from the wheat grain in terms of where it stores nutrients. [2]

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(d) The amino acid sequence of the protein cytochrome C has been used to investigate the evolutionary relationship between organisms. The table below shows the amino acid sequences of parts of the protein from three sources, wheat, barley and maize. The amino acids are represented by using a single letter code, e.g. G = glycine.

SOURCE	Position of amino acid in polypeptide chain																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15-60	61	62	63	64	65	66	67	68	69	70	71	72-112
1	M	D	S	F	A	E	A	P	A	G	N	P	T	T		V	I	W	E	E	N	T	L	Y	D	Y	
2	M	A	P	F	D	E	A	P	P	G	K	S	K	A		V	E	W	E	E	K	T	L	T	D	Y	
3	M	A	S	F	D	E	A	P	P	G	K	P	K	A		V	E	W	E	E	K	T	L	Y	E	Y	

(i) Explain why determining the amino acid sequence of proteins from different organisms can be used to show evolutionary relationships. [1]

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(ii) Count the differences between the amino acid sequences from sources **2** and **3**. Enter your answer in the table below. [1]

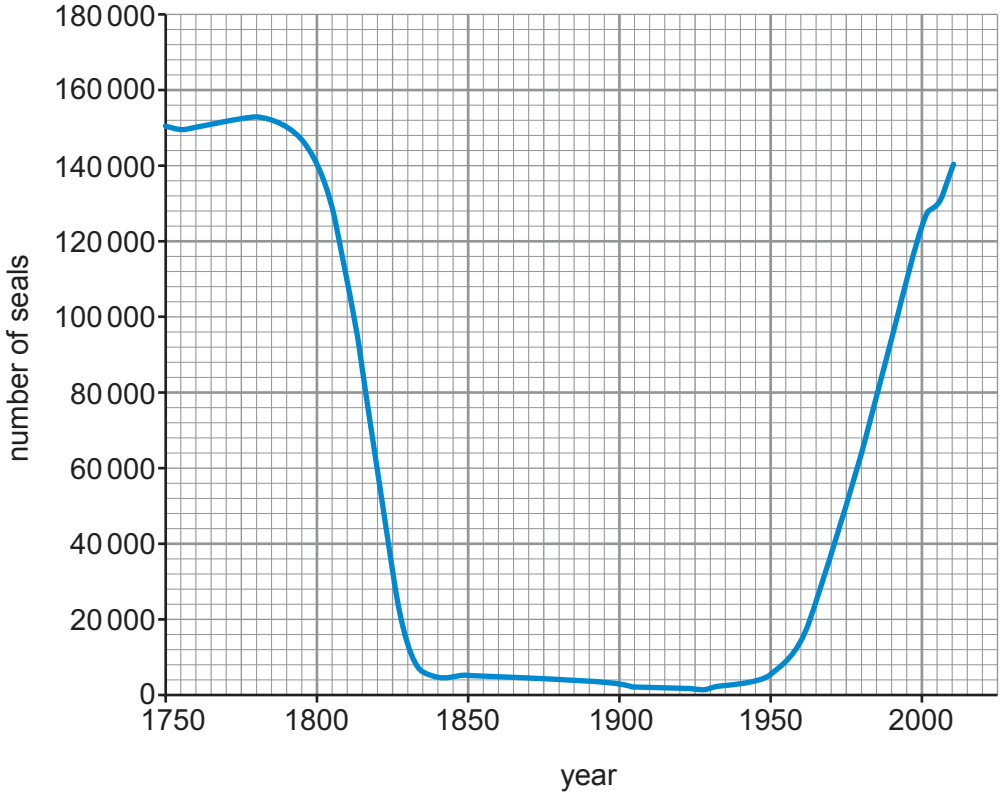
Between sources	No. of differences
1 and 2	11
2 and 3	.....
1 and 3	9

(iii) Use the table above and diagram **1** on page **12** to conclude which source came from which species. [2]

Species	Source
Maize (*Zea mays)*	.....
Wheat *(Triticum aestivum)*	.....
Barley *(Hordeum vulgare)*	.....

2. The northern elephant seal, Mirounga angustirostris, is named because the male has a large nose that resembles an elephant's trunk. They feed on squid, octopus and fish. They have a thick layer of blubber which was used by humans in the nineteenth century to produce lamp oil.

The population curve below shows estimates of the population of northern elephant seals from 1750 to 2010.



(a) Factors affecting population size are described as density dependent or density independent. Use the graph to identify when density dependent and density independent factors would have been acting, between the years 1750 and 1830, and suggest what these factors may have been. [4]

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(b) An event in which the size of an existing population is drastically reduced is called a **population bottleneck**.

By 1910, Northern Elephant Seals were only found on Guadalupe Island off Baja California, Mexico. The species was protected under U.S. and Mexican law early in the twentieth century.

Explain how the graph illustrates an example of a *'population bottleneck'* and describe evidence from the graph which suggests that conservation measures were successful. [2]

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(c) Today, all Northern Elephant Seals are descended from the 50 or so Guadalupe seals.

In order to assess the impact of the population bottleneck on the genetic diversity of northern elephant seals a group of scientists compared nucleotide sequences of DNA. Samples were taken from 185 present day northern elephant seals and compared with 22 museum samples of northern elephant seals collected in the nineteenth century.

Five different base sequences have been identified at the same point in the same gene locus. The results table below shows the number of specimens showing each of these alternative base sequences.

Base sequence at a particular point in the gene locus.	Number of specimens showing this sequence	
	present day	nineteenth century
GTA	50	8
GAA	0	8
GAG	0	4
AAG	135	1
AAA	0	1

[A. Rus Hoelzel *et al*; J. Evol. Biol. **15** (2002) 567-575)]

(i) Name a technique that the scientists could have used to amplify the DNA available from the museum specimens. [1]

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(ii) Give **one** limitation of the experiment that produced the results in the table. [1]

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(iii) With reference to the data, draw a conclusion about the impact of population bottlenecks on genetic diversity of northern elephant seals. [2]

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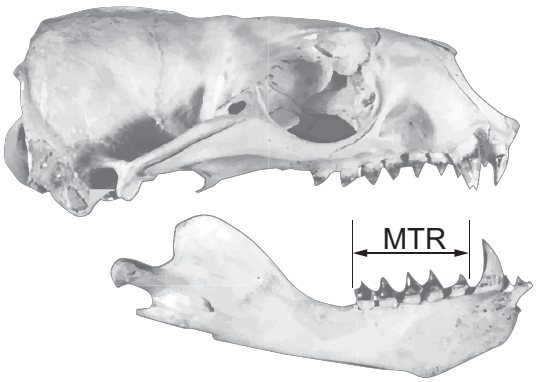
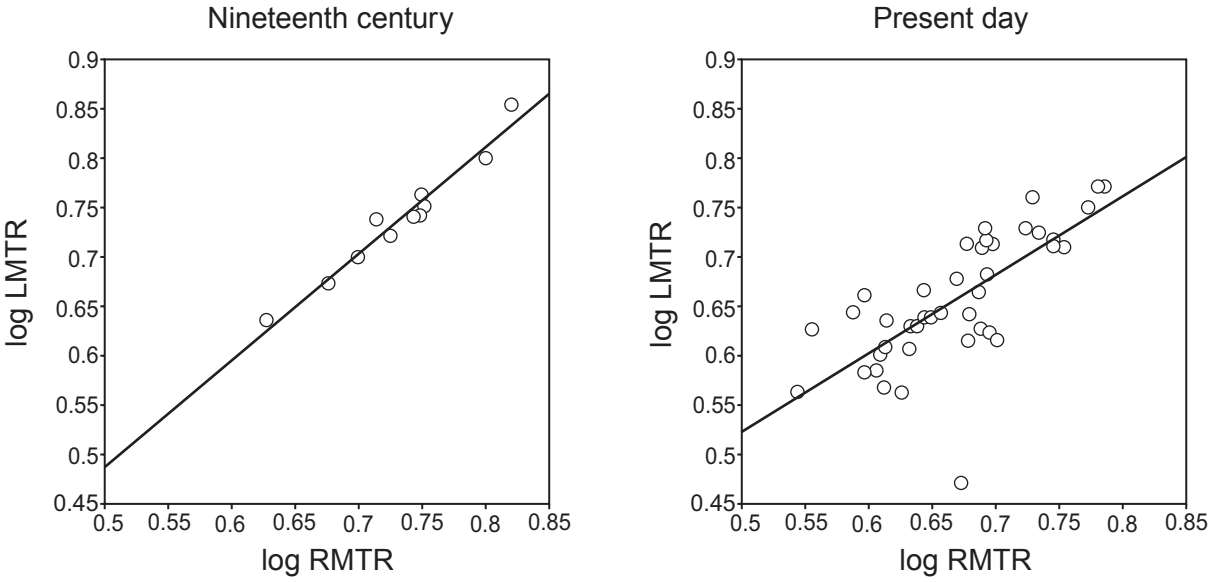
In order to investigate the impact of the population events on development in the northern elephant seals, the same group of scientists also compared the skulls of present day seals with the museum specimens. They measured the length of the Mandibular Tooth Row (MTR) shown in the diagram below. By comparing the lengths from the right and left sides of each skull they were able to assess their symmetry.



The graphs below show the results of plotting logs of values for the Left Mandibular Tooth Row (LMTR) against logs of values for the Right Mandibular Tooth Row (RMTR).



(d) Use the graphs above to draw a conclusion about the impact of population bottleneck of the nineteenth century on the symmetry of skulls in northern elephants seals. [2]

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The scientists also measured the skulls of present day southern elephant seals, *Mirounga leonina*, which did not suffer as badly from the population bottleneck of the nineteenth century.

(e) (i) Using the information, what is the evidence that the northern elephant seal is closely related to the southern elephant seal? [1]

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(ii) How does measuring southern elephant seals improve the validity of the conclusion? [1]

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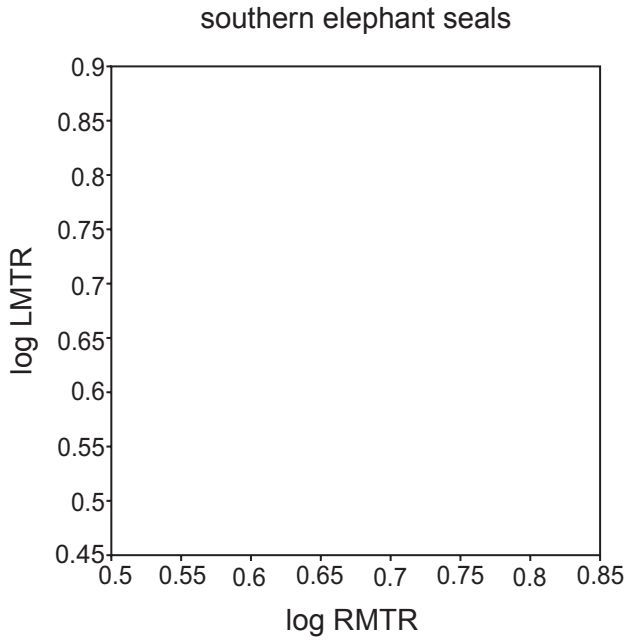
(iii) **Draw a line on the grid below** to represent the expected relationship between the LMTR and RMTR for the southern elephant seals. [1]



(f) How might the effects of the population bottleneck of the nineteenth century on the DNA described in part *(c)* and the development described in part *(d)* affect the survival of northern elephant seals in the future? [2]

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