Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 2

29 October 2025

Zone A morning | **Zone B** morning | **Zone C** morning

Candidate session number

2 hours 30 minutes

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.

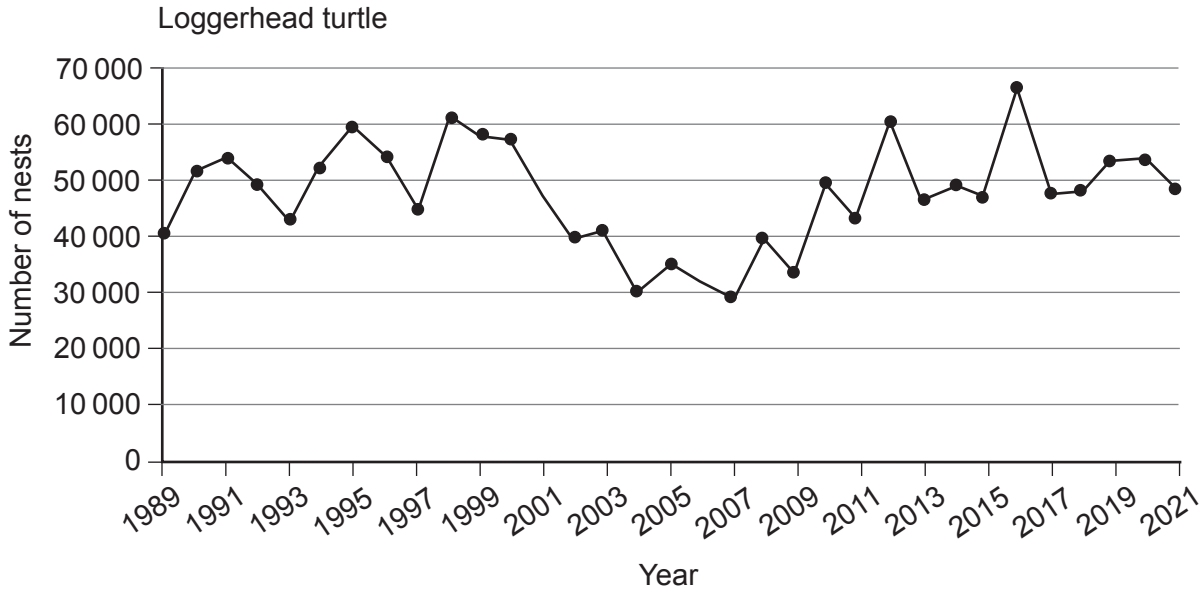
8825 – 6021

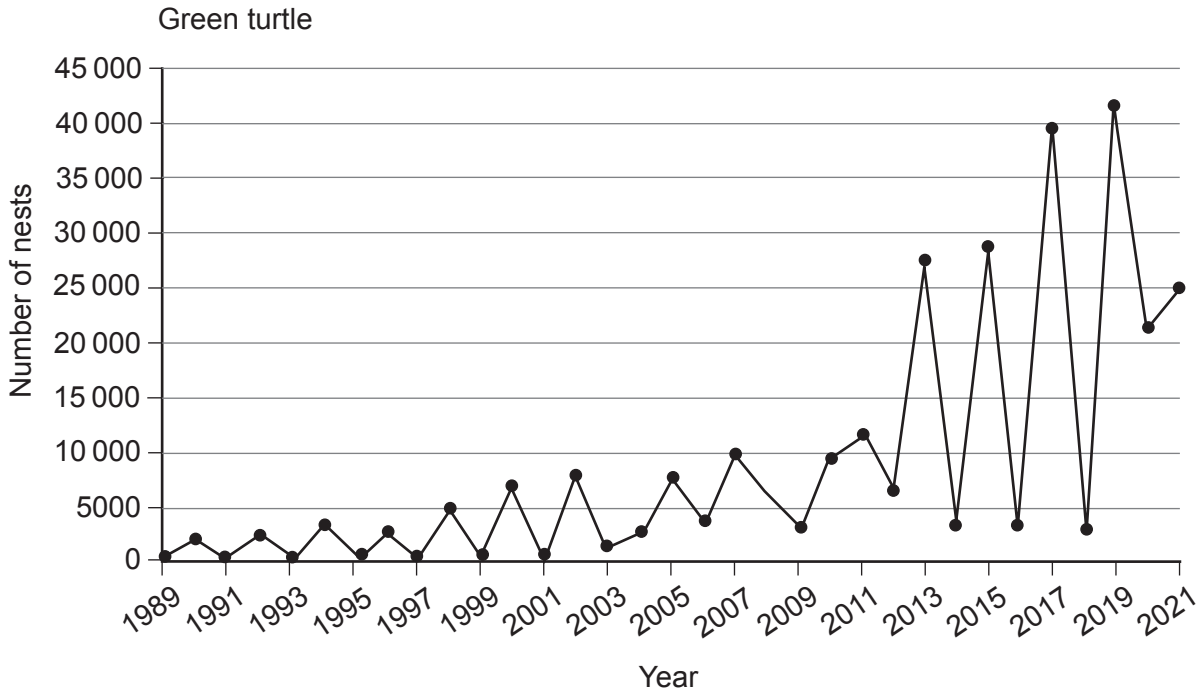
25 pages

Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. To estimate the size of the turtle population, the Fish and Wildlife Research Institute (FWRI) conducted an annual survey along the coast of Florida from 1989 to 2021. They counted the number of turtle nests on selected beaches where turtles lay their eggs. The graphs show the results for the loggerhead turtle (*Caretta caretta*) and the green turtle (*Chelonia mydas*).





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(Question 1 continued)

(a) State the year in which most loggerhead turtle nests were counted in the survey. [1]

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(b) Compare and contrast the change in the annual number of nests for the two species of turtle. [3]

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(c) Suggest the limitations of only using nesting turtles to estimate the annual population. [2]

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(Question 1 continued)

Mortality or injury from being struck by a motorized water vessel (boat or craft) is a considerable risk for all turtles. Researchers studied stranded (dead, sick or injured) turtles found in Florida from 1986 to 2014, and identified those with a vessel strike injury (VSI). The turtles were classified as having either a definite vessel strike injury (DVSI) or a probable vessel strike injury (PVSI). The table shows the results for six species of turtle.

Species	Number of stranded turtles	Number with a DVSI	Number with a DVSI or a PVSI	% with a DVSI	% with a DVSI or a PVSI
Loggerhead (*Caretta caretta*)	19 111	4217	5983	22.1	31.3
Green (*Chelonia mydas*)	11 631	2763	3758	23.8	32.3
Kemp's ridley (*Lepidochelys kempii*)	2738	413	714	15.1	26.1
Leatherback (*Dermochelys coriacea*)	620	133	213	21.5	34.4
Hawksbill (*Eretmochelys imbricata*)	635	57	94	9.0	14.8
Olive ridley (*Lepidochelys olivacea*)	4	0	0	0.0	0.0
Unknown	1067	108	200	10.1	18.7

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(Question 1 continued)

(d) State which species had the greatest percentage of stranded turtles with a DVSI. [1]

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(e) Suggest a reason for the difference between the percentage of each species that had DVSIs. [1]

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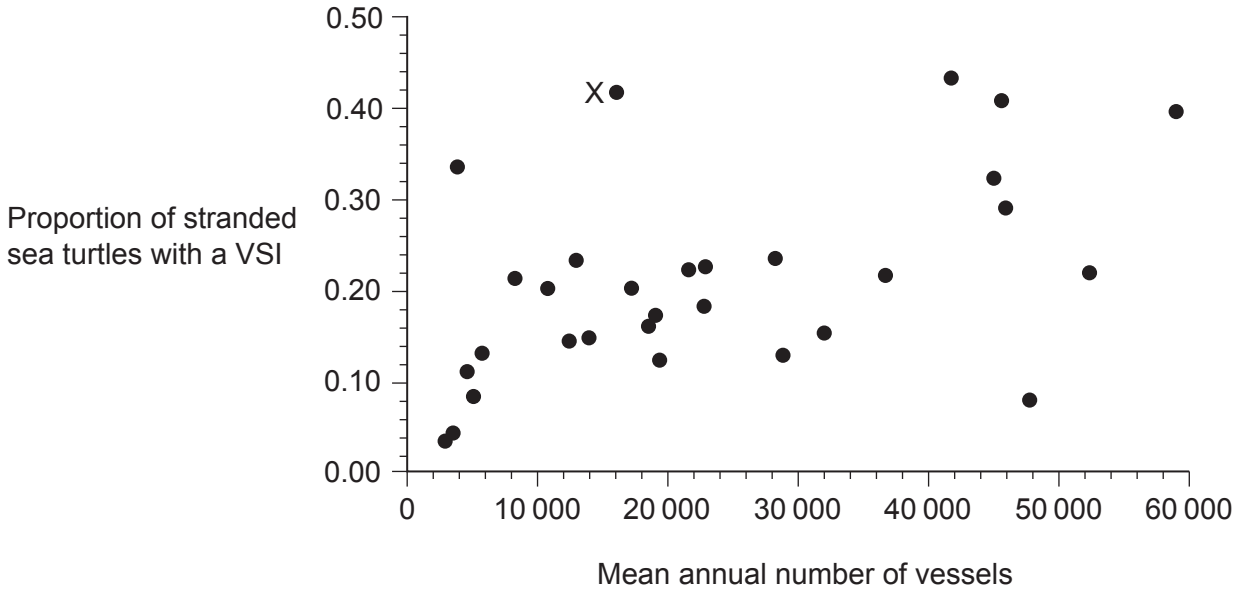
(Question 1 continued)

The graph shows the mean annual number of vessels in coastal regions of Florida and the proportion of stranded turtles found with a VSI.



(f) State the relationship between mean annual number of vessels and turtles with VSIs. [1]

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(g) A researcher suggested that the point labelled X is considered atypical.
Outline a reason for this researcher's opinion. [1]

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(Question 1 continued)

(h) Evaluate the hypothesis that water vessels are the main cause of turtle deaths in Florida. [3]

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2. Pathogens are disease-causing organisms.

(a) State **two** of the body's primary defences to pathogens. [2]

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(b) Outline **two** reasons for the very rapid rates of evolution in some viruses. [2]

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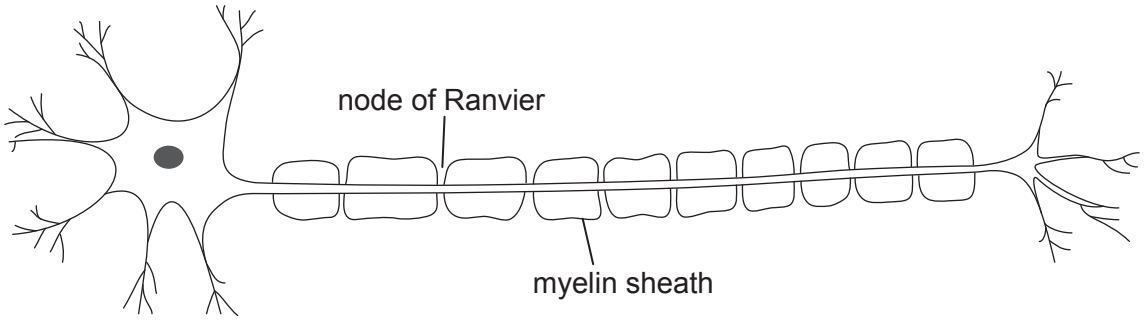
3. The diagram shows a cell from the nervous system.



(a) Outline how the myelin sheath and nodes of Ranvier increase the speed of an action potential along a neuron. [2]

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(b) Compare and contrast the movement of particles across plasma membranes by simple diffusion and facilitated diffusion. [2]

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(c) Describe the effect of neonicotinoid pesticides on synaptic transmission in insects. [3]

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4. (a) Explain how the pressure potential and solute potential change inside a plant root cell when it is placed into a solution that is more hypotonic than the cell's cytoplasm. [3]

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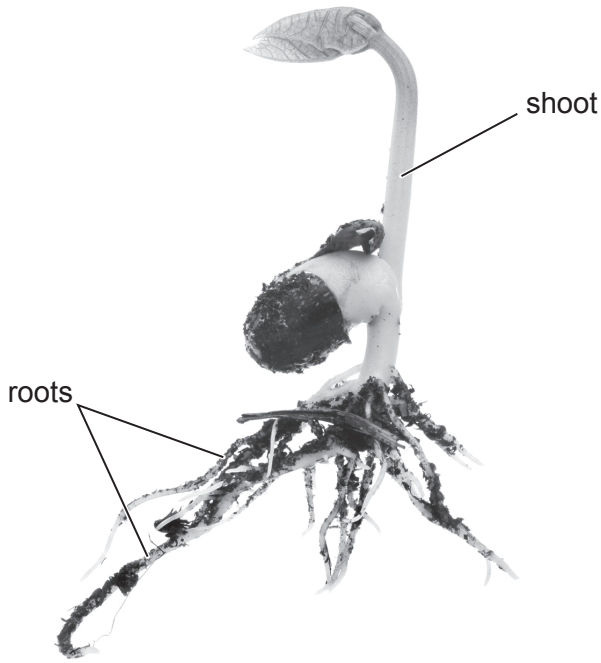
(b) The photograph shows a seedling (young plant) of the family Fabaceae. The shoot and roots have been labelled.



(i) Explain how root pressure is generated to cause movement of water through seedlings. [2]

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(Question 4 continued)

(ii) State the name and site of production of **two** phytohormones that regulate the growth of seedlings. [2]

Name of phytohormone	Site of production

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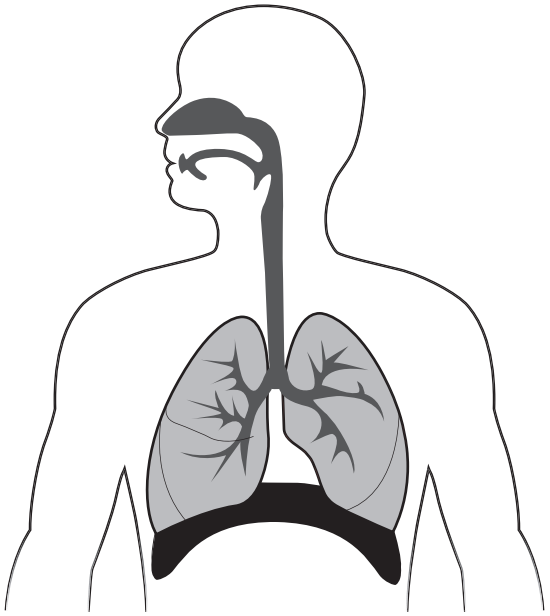
will not be marked.

5. The image shows the location of the lungs and diaphragm in a human.



(a) Explain how contraction of the diaphragm causes air to enter the lungs. [2]

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(b) State another muscle group that causes inspiration when it contracts. [1]

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(c) Outline the role of surfactant in the mammalian lung. [2]

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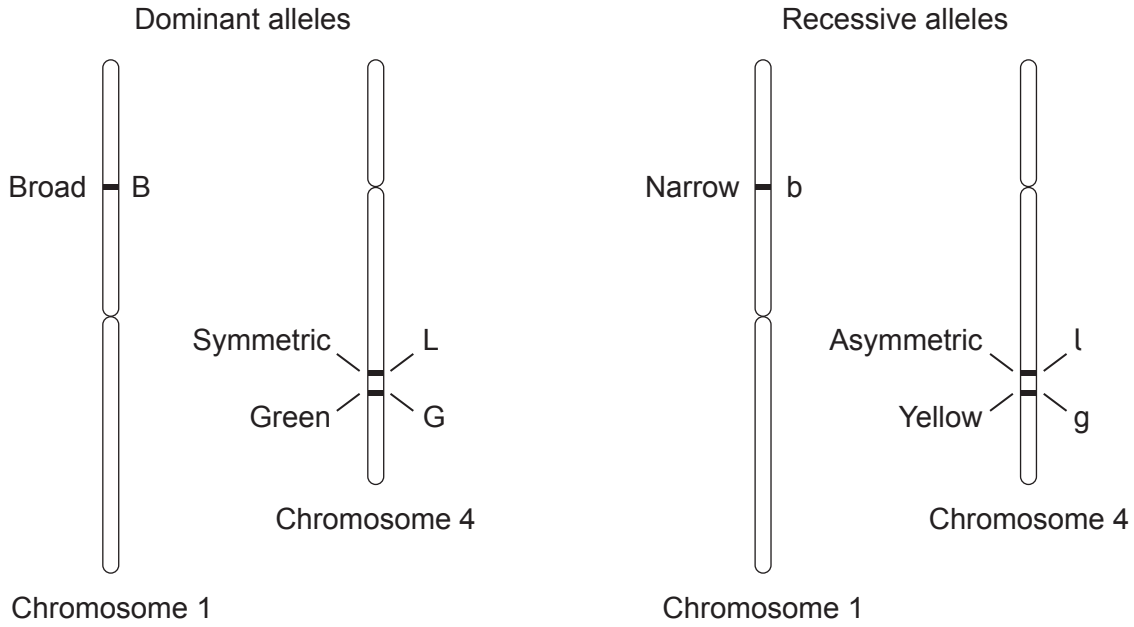
6. Scientists determined the loci of three genes on chromosomes 1 and 4 of the thale cress plant (*Arabidopsis thaliana*). All three genes are involved in influencing the characteristics (width, symmetry and colour) of the plant's leaves.

The diagrams show the names and symbols of the alleles of these genes.



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(Question 6 continued)

(a) The expected ratio of phenotypes in the offspring of a cross between a plant with narrow, yellow leaves and a plant heterozygous for the genes for leaf width and colour is 1:1:1:1.

Justify this expected ratio using a Punnett grid or other diagram. [3]

(b) Explain whether a ratio of 1:1:1:1 would be expected in the offspring of a cross between a plant with asymmetric, yellow leaves and a plant heterozygous for the genes for leaf symmetry and colour. [2]

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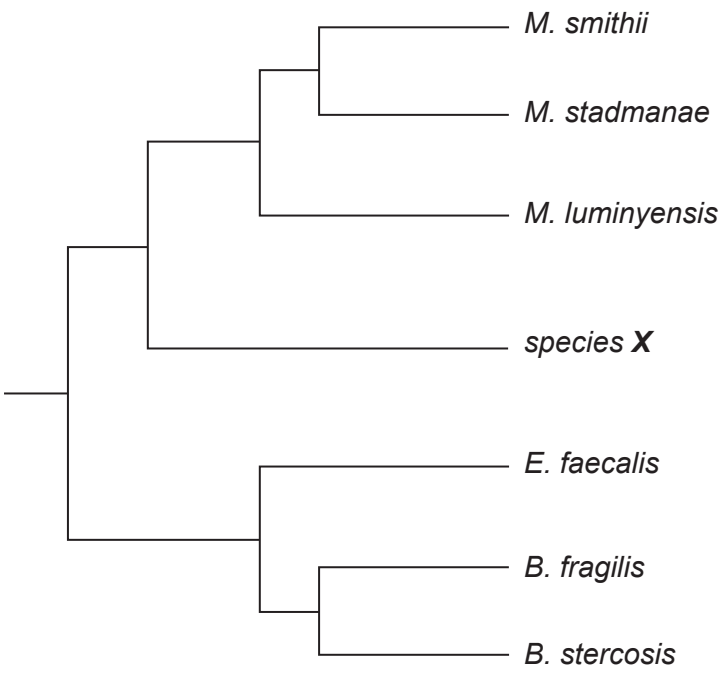
7. The gut of a healthy human contains more than 1000 species of bacteria. Some of these species are shown in the cladogram.



(a) Identify, with a reason, whether the cladogram shows species **X** is more closely related to *M. luminyensis* or to *E. faecalis*. [2]

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(Question 7 continued)

(b) Scientists have found that *B. fragilis* and *B. stercosis* are keystone species in the human gut ecosystem.

(i) Define keystone species. [2]

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(ii) Over time, the populations of different species of bacteria in the human gut can produce a stable climax community.

Suggest how some antibiotics, prescribed for bacterial infections, can disrupt the climax community in the gut. [2]

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(c) Outline a difficulty in applying the biological species concept to bacteria. [1]

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Section B

Answer **two** questions. One additional mark is available for the construction of your answers for each question. Answers must be written within the answer boxes provided.

8. Monosaccharides can be used to make polysaccharides, and can also be combined with other types of carbon compound to form molecules such as nucleotides.

(a) Using named examples, explain the relationships between the structure of carbohydrates and their properties and functions in cells. [7]

(b) Outline, with examples, the wide range of uses of adenosine triphosphate (ATP) in cells. [5]

(c) Distinguish between the roles and locations of reduced hydrogen carriers in aerobic respiration and photosynthesis. [3]

9. The complementarity of shapes and chemical properties allows molecules to bind to each other.

(a) Describe, with examples, the types of molecule within cell-to-cell signalling systems that are complementary to each other. [4]

(b) Explain the possible causes of changes to enzyme active sites and the consequences of these changes. [7]

(c) Outline how reversible changes to haemoglobin molecules increase the efficiency of oxygen transport within the human body. [4]

10. There is evidence that RNA was used as a genetic material in living organisms before DNA.

(a) Describe the structure of RNA and the evidence that it was the first genetic material used to store information. [5]

(b) Describe how analysis of DNA base sequences can be used in the conservation of biodiversity. [3]

(c) Explain the causes and consequences of changes in the base sequences of DNA in a species over many generations. [7]

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References:

1.a Florida Fish and Wildlife Conservation Commission, 2023. *Index Nesting Beach Survey Totals (1989–2023)*. [image online] Available at: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/ [Accessed 25 October 2024]. Source adapted.

1.d Foley, A.M., Stacy, B.A., Hardy, R.F., Shea, C.P., Minch, K.E. and Schroeder, B.A. (2019), Characterizing watercraft-related mortality of sea turtles in Florida. *Jour. Wild. Mgmt.*, 83: 1057–1072. https://doi.org/10.1002/jwmg.21665.

1.f Foley, A.M., Stacy, B.A., Hardy, R.F., Shea, C.P., Minch, K.E. and Schroeder, B.A. (2019), Characterizing watercraft-related mortality of sea turtles in Florida. *Jour. Wild. Mgmt.*, 83: 1057–1072. https://doi.org/10.1002/jwmg.21665.

4. Griffin24, 2014. *Germinating bean seed*. [image online] https://www.gettyimages.co.uk/detail/photo/germinating-bean-seed-royalty-free-image/517816303 [Accessed 4 December 2024]. Source adapted.

5. paveugra, 2015. *Respiratory system*. [image online] Available at: https://www.gettyimages.co.uk/detail/illustration/respiratory-system-royalty-free-illustration/489734346 [Accessed 6 December 2024]. Source adapted.

6.a Řepková, J, Hlaváčová, S., Lízal, P., Kyjovská, Z. and Relichová, J., 2005. *Fig. 2. Genetic map of* Arabidopsis thaliana *with DNA markers and new mutant loci indicated*. [image online] Available at: https://ogmb.sci.muni.cz/media/3202562/repkova2005.pdf [Accessed 29 October 2024]. Source adapted.

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Dridi, B., Fardeau, M.-L., Ollivier, B., Raoult, D. and Drancourt, M., 2012. *Methanomassiliicoccus luminyensis* gen. nov., sp. nov., a methanogenic archaeon isolated from human faeces. *International Journal of Systematic and Evolutionary Microbiology*, [online] Available at: https://www.microbiologyresearch.org/content/journal/ijsem/10.1099/ijs.0.033712-0 [Accessed 6 December 2024]. Source adapted.

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