



GCSE

4781/03-A



W15-4781-03A-R1

SCIENCE B

UNIT 1: Space, Energy and Life

P.M. THURSDAY, 15 January 2015

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Resource Folder (Pre-Release Article)

For use with:

GCSE Science B (UNIT 1) **SECTION B** of the Foundation Tier

GCSE Science B (UNIT 1) **SECTION A** of the Higher Tier

Pre-Release Article – Dissolved oxygen and aquatic life

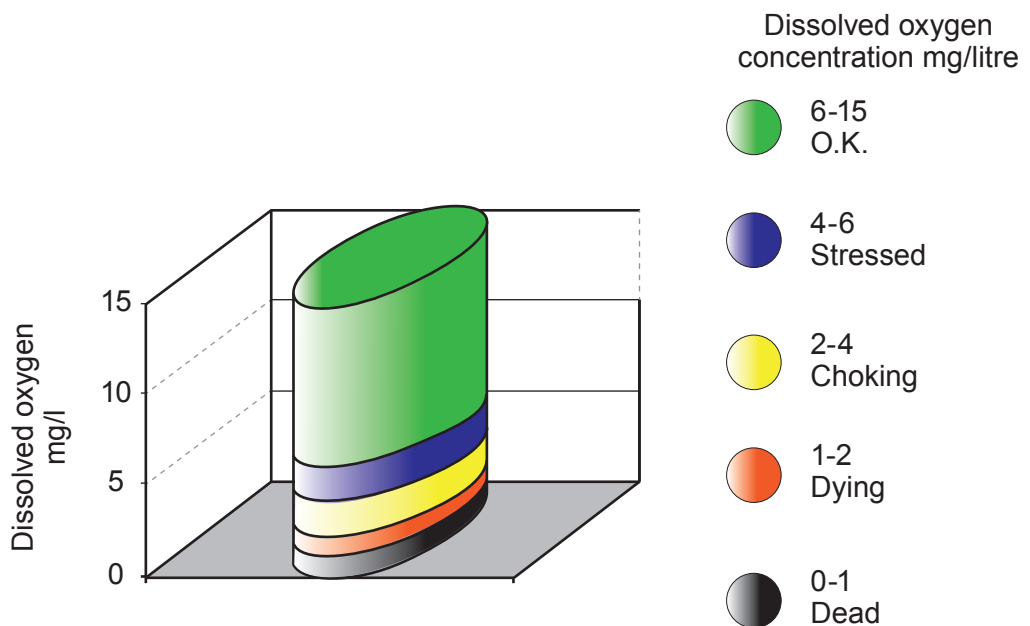
In the 1970s, Chesapeake Bay, USA was discovered to contain one of the planet's first identified marine dead zones. The waters were so depleted of oxygen (hypoxic) that they were unable to support life, resulting in the death of massive numbers of fish.

Where does dissolved oxygen come from?

There are two main sources of dissolved oxygen: air and photosynthesis. Both phytoplankton and plants can be found in water. These organisms are net producers of oxygen in the daytime, but at night become net consumers of oxygen. At the surface of the water, oxygen from the air **equilibrates** with oxygen dissolved in the water. Moving water has a rougher surface than still water. With more surface area in contact with air, moving water will equilibrate with air more quickly.

Oxygen depletion occurs as dissolved oxygen (**DO**) becomes reduced in concentration. **DO** is measured in milligrams per litre (mg/l).

Diagram 1 How much oxygen in the water do aquatic creatures need?



What causes dissolved oxygen levels to vary?

The amount of dissolved oxygen will be determined by:

- how much oxygen the water can hold (temperature-dependent)
- the depth of the water
- how much surface area is available for diffusion from the air
- how much oxygen is produced by photosynthesis
- how much oxygen is consumed by respiration.

Graph 1. How dissolved oxygen concentration (DO) varies with the month in the year

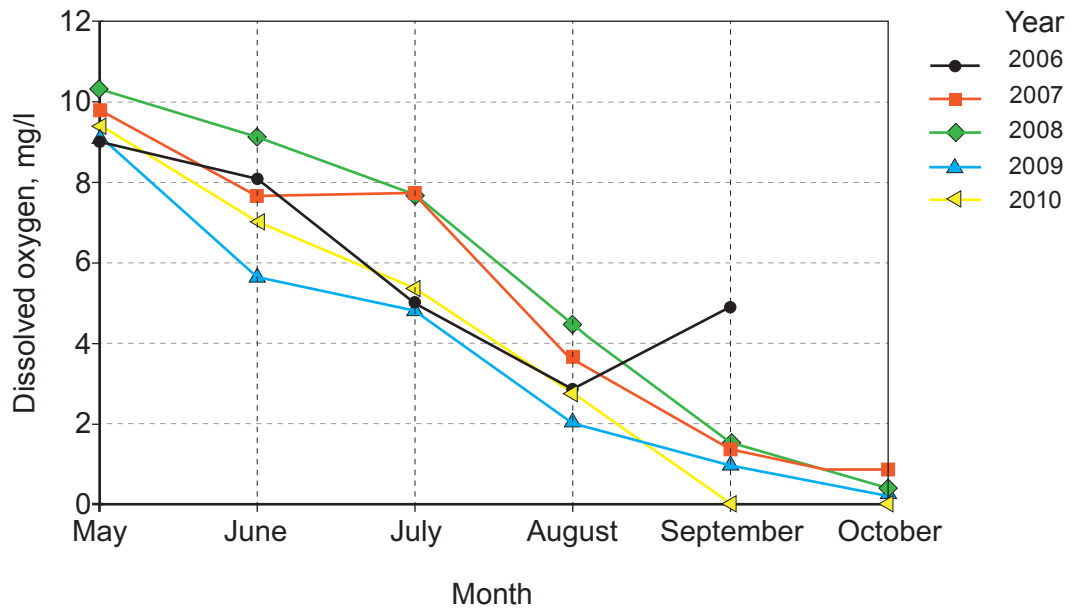


Table 1. How maximum dissolved oxygen concentration (DO) varies with temperature

Temperature (°C)	DO (mg/l)	Temperature (°C)	DO (mg/l)
0	14.60	23	8.56
1	14.19	24	8.40
2	13.81	25	8.24
3	13.44	26	8.09
4	13.09	27	7.95
5	12.75	28	7.81
6	12.43	29	7.67
7	12.12	30	7.54
8	11.83	31	7.41
9	11.55	32	7.28
10	11.27	33	7.16
11	11.01	34	7.16
12	10.76	35	6.93
13	10.52	36	6.82
14	10.29	37	6.71
15	10.07	38	6.61
16	9.85	39	6.51
17	9.65	40	6.41
18	9.45	41	6.41
19	9.26	42	6.22
20	9.07	43	6.13
21	8.90	44	6.04
22	8.72	45	5.90

Graph 2 How the mean daily water temperature varies with the month in the year

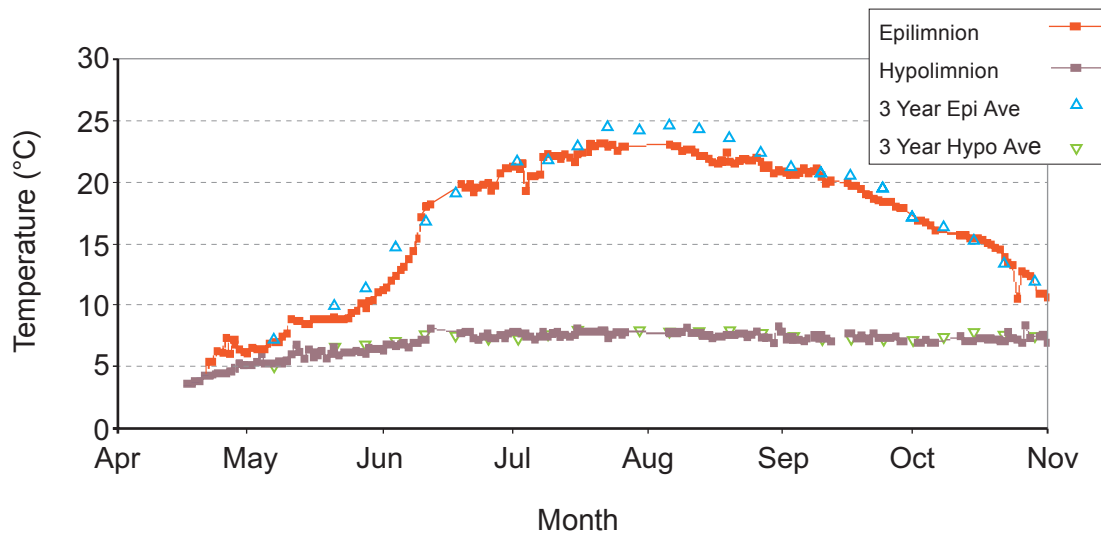
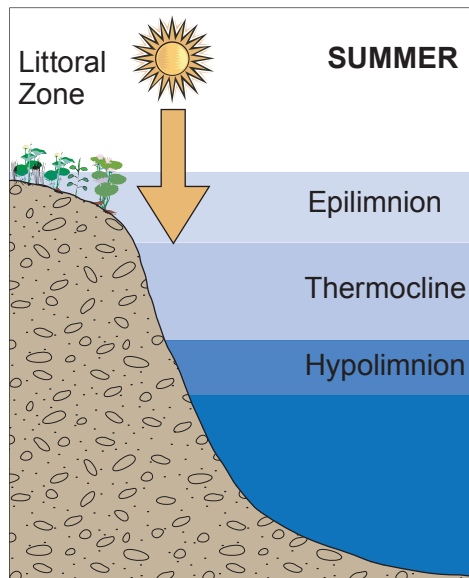
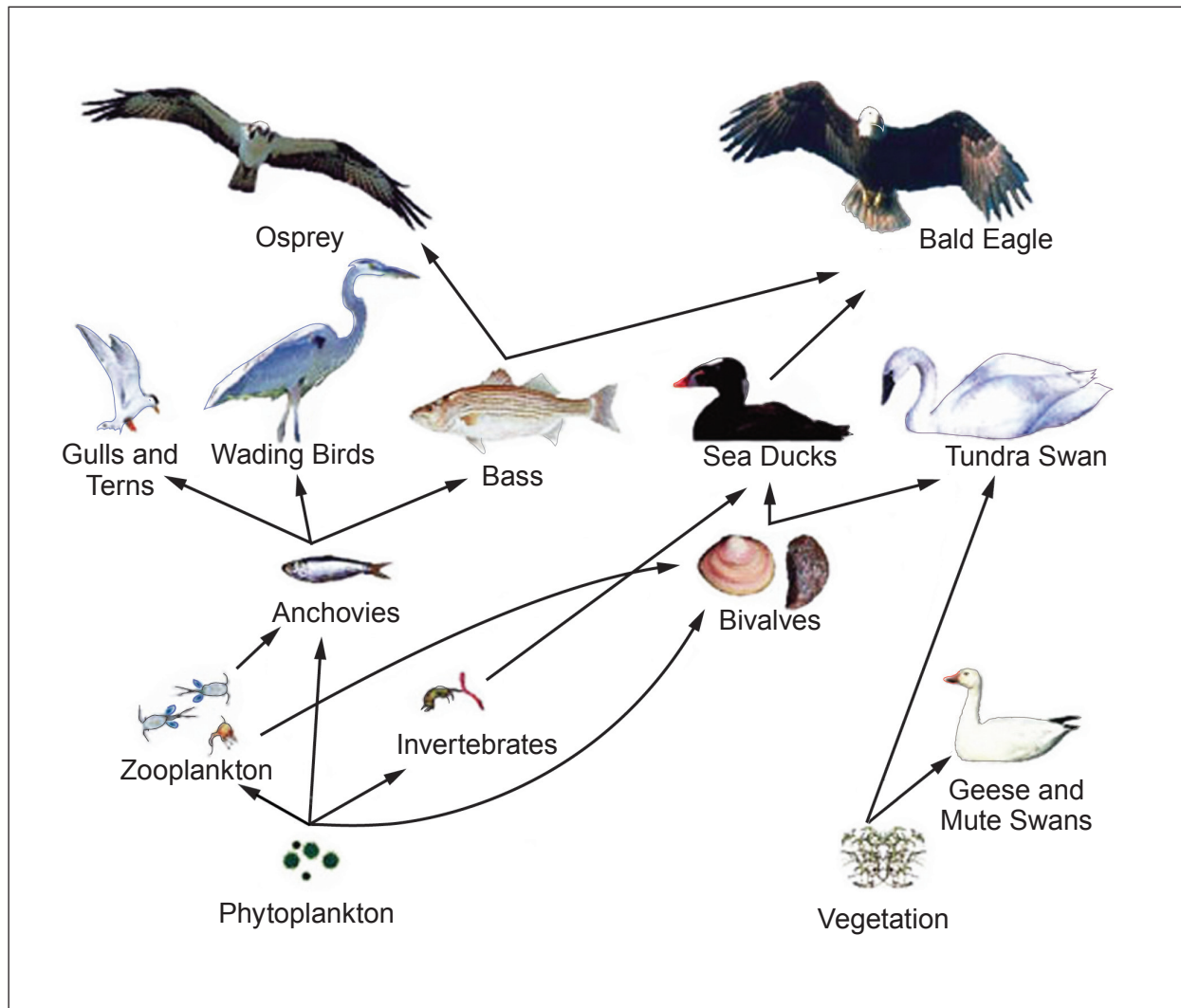


Diagram 2 How depth affects the dissolved oxygen concentration



The sun heats the top layer of water, the epilimnion, which causes it to become less dense. The bottom layer, the hypolimnion, does not receive sunlight and therefore remains cold. Since the epilimnion is less dense, it floats above the hypolimnion and the two do not mix. The thermocline is the dividing area between the top and bottom layers. The epilimnion is the only part of the lake that sunlight can penetrate.

Diagram 3 Chesapeake foodweb



Acknowledgements:

http://www.epa.gov/glnpo/monitoring/d_o/

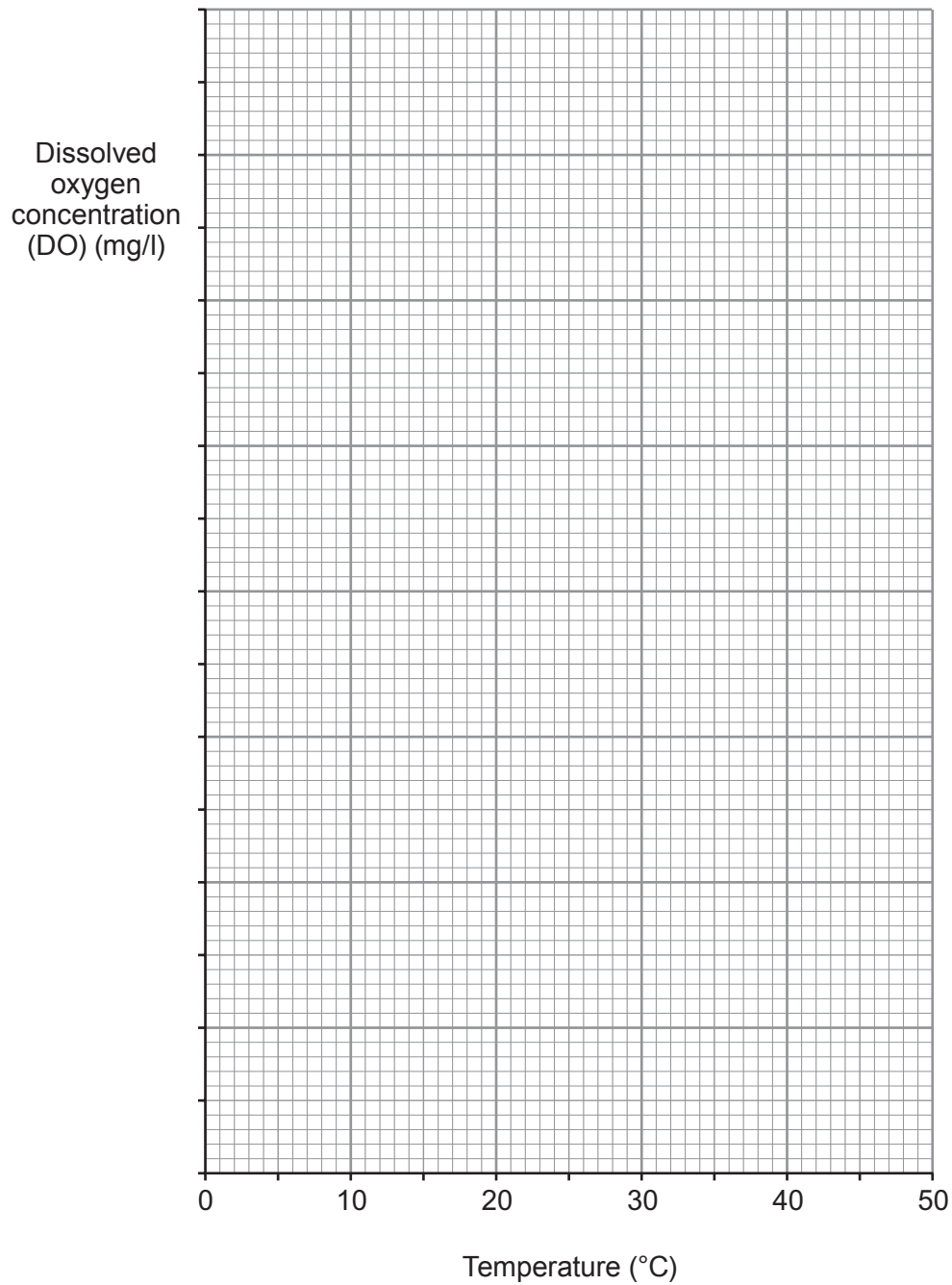
http://en.wikipedia.org/wiki/Chesapeake_Bay

Answer all questions in the spaces provided.

Use the information in the separate Resource Folder to answer the following questions.

1. (a) (i) Give **one** reason why phytoplankton and plants **only** increase the oxygen concentration during sunlight hours. [1]
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-
- (ii) Give **one** reason why living phytoplankton and other plants are **only** found in the epilimnion layer of water. [1]
-
-
- (b) Name the process by which phytoplankton and plants will decrease the oxygen concentration at night. [1]
-
- (c) (i) Use the information in **Table 1** to complete the table below and then plot a graph to show how the dissolved oxygen concentration varies with temperature. [5]

Temperature (°C)	Dissolved oxygen concentration (DO) (mg/l)
0
6
10
14
20
26
30
40



- (ii) Describe the pattern shown by your graph. [2]

.....

.....

- (iii) Continue your graph to estimate the temperature at which oxygen levels become low enough to cause stress to fish. [1]

.....

- (d) (i) Use **Graph 2** and your answer to (c)(ii) to describe how the dissolved oxygen concentration will vary in the epilimnion between May and November. [3]

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.....

- (ii) Use the information in **Diagram 1** and **Graph 1** to complete the table below for the year **2006**. [4]

Month	Dissolved oxygen concentration (DO) (mg/l)	Condition of fish
May	9	OK
June
July
August
September

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GCSE MARKING SCHEME

SCIENCE B

JANUARY 2015

Question		Marking point	Marks																		
1	(a) (i)	That is the time <u>photosynthesis</u> occurs [1]	1																		
	(ii)	Light penetrates this layer / does not penetrate lower. [1]	1																		
	(b)	Respiration [1]	1																		
	(c) (i)	<table border="1"><thead><tr><th>Temperature (°C)</th><th>Dissolved oxygen (DO) (mg/l)</th></tr></thead><tbody><tr><td>0</td><td>14.60</td></tr><tr><td>6</td><td>12.43</td></tr><tr><td>10</td><td>11.27</td></tr><tr><td>14</td><td>10.29</td></tr><tr><td>20</td><td>9.07</td></tr><tr><td>26</td><td>8.09</td></tr><tr><td>30</td><td>7.54</td></tr><tr><td>40</td><td>6.41</td></tr></tbody></table> <p>Table [1] DO scale which covers at least half the axis [1] Points [2] Smooth curve [1]</p>	Temperature (°C)	Dissolved oxygen (DO) (mg/l)	0	14.60	6	12.43	10	11.27	14	10.29	20	9.07	26	8.09	30	7.54	40	6.41	5
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(ii)	As temperature increases the dissolved oxygen decreases / negative correlation [1] non uniformly [1]	2																			
(iii)	Between 44-45°C (from candidates graph)	1																			
(d) (i)	Temperature increases (May-Aug) <u>and</u> then decreases (to Nov) [1] (May to August) DO decreases <u>and</u> then increases (to November) [1] reference to months [1]	3																			
(ii)	Each line [1] x 4	4																			
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Question		Marking point	Marks
	(e)	<p>Indicative content</p> <ul style="list-style-type: none"> • Food supply / prey of the anchovies will increase i.e. zooplankton and phytoplankton. • Less competition for these food sources will result in an increase in invertebrates and bivalves. • Animals that feed on anchovies will decrease in number e.g. gulls, waders and bass. • Since they have no other food source they may die. • Ospreys will decrease / die. • Bald eagles will feed more on Sea Ducks so their numbers will decrease meaning less competition for swans so their number will increase <p>Marking bands</p> <p>5-6 marks. The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p>	6

GCSE SCIENCE

JANUARY 2015 MARK SCHEME

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