



**ST PAUL'S SCHOOL
JUNIOR SCHOLARSHIP EXAMINATION**

BIOLOGY

NAME _____

MAY 2015

SECTION B – BIOLOGY

Of all the classes of vertebrates, birds are arguably the most diverse, with over 9000 different species.

1. Most birds can fly. Suggest three advantages that flying gives a bird.

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.....

[3]

We know from the fossil record that birds evolved about 100 million years ago from dinosaurs that developed feathers. The most famous extinct ancestor of birds is *Archaeopteryx*. Fig. 1 shows a labelled drawing of the first *Archaeopteryx* fossil discovered, which was found in a quarry in Germany.

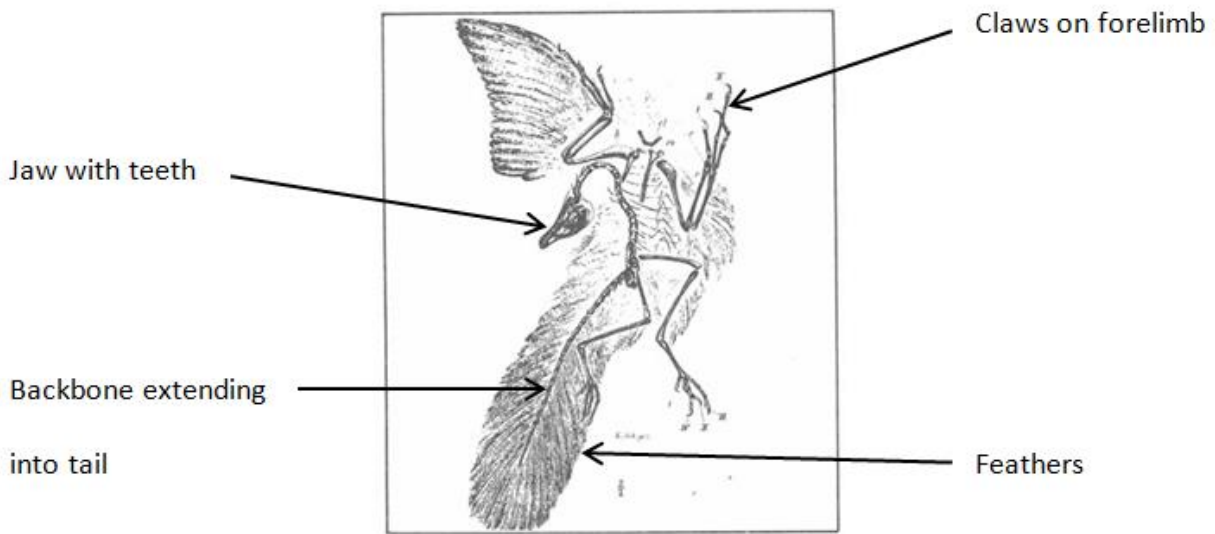


Figure 1

2. From the four features shown labelled on the drawing, which ONE feature is found in all birds?

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Which ONE feature is never found in birds, but is found in ALL reptiles?

.....

[1]

Based on careful study of their anatomy and also DNA differences, an evolutionary family tree has been worked out for the origins of birds, reptiles such as crocodiles and lizards, and snakes, and their extinct dinosaur and Pterosaur relatives, shown in **Fig. 2** below.

Time runs left to right, with successive branching in the family tree as ancient ancestors gave rise to different forms. Each branching point represents an extinct common ancestor of all animals that are descended from it.

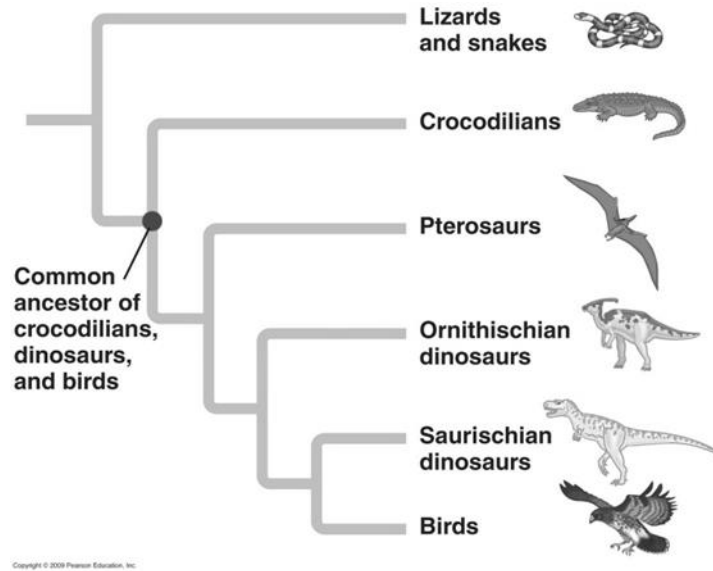


Figure 2

3. Which of the following statements do you think are supported by the family tree shown?

(Put a tick by any statement that you think is supported by the diagram, and a cross by any you think is not.)

- (i) Birds have a more recent common ancestor with crocodiles than lizards do.
- (ii) Of all the animals shown, birds are the closest living relatives of the dinosaurs.
- (iii) Crocodiles evolved from dinosaurs.

[3]

Some scientists have argued that birds should really be classified as a type of reptile.

4. Based on the evolutionary tree, suggest why this might be logically correct.

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[2]

TURN OVER

5. Why do you think birds are traditionally classified as a separate group?

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[2]

All birds lay hard-shelled eggs, containing a liquid yolk sack with all the nutrients and water the embryo needs to grow. The shell is porous – it contains microscopic holes which pass right through the shell and allow gases to pass through, but not liquid water. A microscopic view of a section through an egg is shown in **Fig. 3** below.

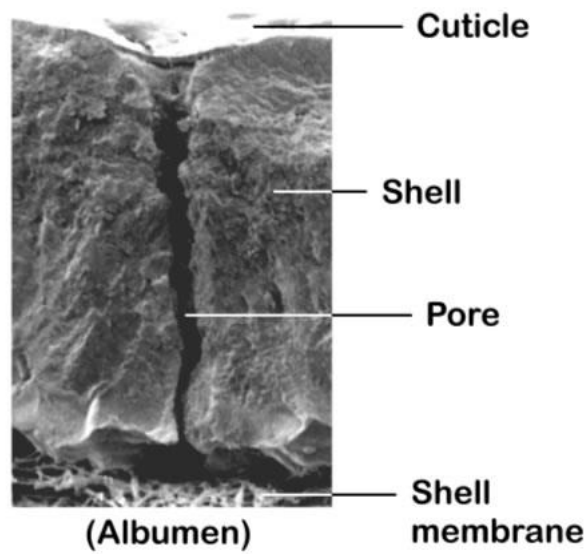


Figure 3

6. Suggest why gases must be able to pass through the shell.

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[3]

The largest eggs are laid by large flightless birds, such as the ostrich and the emu.

The Elephant bird of Madagascar, which went extinct around the 17th century, laid the largest bird eggs ever found - with a volume 160 times bigger than that of a chicken's egg. The two are shown for comparison in *Fig. 4*.



Figure 4

7. Suggest why it is an advantage for bigger birds to lay bigger eggs than smaller birds.

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[3]

TURN OVER

There appears to be an upper limit to how large eggs can be, linked to problems with making the shell too thick. Even the biggest dinosaurs laid eggs only slightly larger than those laid by the Elephant bird.

BIRD SPECIES	EGG VOLUME (cm ³)	SHELL THICKNESS (mm)
Crow	13	0.4
Horned Owl	62	0.8
Pelican	147	1.3
Crane	223	1.1
Emu	480	1.3
Ostrich	1260	1.5

Table 1. The eggshell thickness for bird eggs of different sizes.

8. Plot the data on the graph paper provided, with egg volume on the x-axis and shell thickness on the y-axis. Join the points with ruled straight lines in pencil.

Start the scale for your axes in the bottom left hand corner of the graph paper to ensure it fits on the paper, with egg volume on the longer axis. [3]

9. Describe how the shell thickness changes as volume increases.

.....

 [2]

10. Suggest why the thickness has to change for larger eggs.

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 [2]

11. Elephant bird eggs were around 3.5 mm thick. Suggest why hard shelled eggs which are thicker than 4 mm have never been laid by any animal.

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 [1]

END OF BIOLOGY

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