

The Bones and Stones Quiz Book: 200 Questions on Natural History

David Maskill

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For the love of my life, beautiful wife, Jordi

Foreword	1
CHAPTER 1: ID	3
Riddles	4
I Spy (animals)	6
Songs	8
Larvae	10
Prints	12
Homes	13
I Spy (plants)	15
Mystery objects	18
Fossils	20
Habitats	22
Tasty Fungi	24
Faeces	27
Snouts	29
Magnified	31
CHAPTER 2: TAXONOMY	33
Correct Order	34
Connections	44
Odd One Out	49
Lineages	59
CHAPTER 3: TRIVIA	69
True or False	70
Palaeontology	70
Ethology	70
Humorous scientific names	70

Mycology	71
Bonus	72
Ornithology	73
Naturalists	78
Anatomy and Physiology	80
Cryptozoology	84
Darwin's Puzzles	87
Mineralogy	88
Numbers	90
Alpines	92
SOLUTIONS	93
Chapter 1: ID	94
Riddles	94
I Spy (animals)	94
Songs	94
Larvae	95
Prints	95
Homes	95
I Spy (plants)	96
Mystery objects	96
Fossils	96
Habitats	97
Tasty Fungi	98
Faeces	98
Snouts	98
Magnified	99

Chapter 2: Taxonomy	100
Correct Order	100
Connections	101
Odd One Out	102
Lineages	103
Chapter 3: Trivia	105
True or False	105
Palaeontology	105
Ethology	106
Humorous scientific names	107
Mycology	107
Bonus	108
Ornithology	108
Naturalists	109
Anatomy and Physiology	110
Cryptozoology	113
Darwin's Puzzles	114
Mineralogy	116
Numbers	117
Alpines	119
About the Author	120

Foreword

This is a quiz book for naturalists — scientists, scholars, and enthusiasts of natural history, professional and amateur alike (including those who just like poking around in rock pools). Broadly speaking, natural history is the study, predominantly through fieldwork, of the natural world: mainly biology and geology. Or, to put it in simpler terms: animal, vegetable, or mineral. And if you can't decide which category something falls into, congratulations — you might have discovered a new species, or possibly just a very confused fungus.

The natural world includes other physical phenomena too. Let us not forget meteorology, for example, though these days, naturalists seem primarily concerned with bird-watching, moth-trapping, and arguing over the correct way to pronounce "lichen." And of course, the collecting. Naturalists must collect *everything*: fossils, eggs, pinned insects, curious rocks, skulls, seaweed, owl pellets, and an ever-growing pile of field guides you swear you'll read one day.

I love collecting these things, and maybe you do too. Perhaps you discovered this book through my YouTube channel, where I ramble enthusiastically about natural history and, on occasion, medicine. If so, I promise

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you'll enjoy yourself. I've tried to include topics from across the entire spectrum of natural history, so you shouldn't get bored — unless you dislike fun, in which case, I can't help you. If you're struggling, the answers are at the back (but no peeking unless truly desperate). Enjoy!

CHAPTER 1: ID

The most enviable skill for any naturalist is the ability to identify any given animal, plant, or mineral. For example, are you really a twitcher if you can't tell the difference between a house finch and a house sparrow? The answer, of course, is yes. We are all learning. That's the joy of it. The most enjoyable hikes through a nature reserve are those where you're with somebody who knows more than you, at least in my experience. While this is a quiz book at heart, then, hopefully what you'll enjoy most are the questions you get wrong, because then you'll learn something new.

Riddles

Perhaps you can list every type of cloud, describe the features of each family of mosses, or pick out the raven among the crows, but can you do it in AI-generated riddle form?

A spine of white across the blue,
A skeletal form in heaven's view.
Though made of ice, I do not bite,
A fleeting ghost in morning light.
What am I?

I drink the rain but never drown,
A sponge that paints the wetlands brown.
In bogs I build a bed so deep,
Where ancient secrets lie asleep.
What am I?

I hoard the future in the ground,
Yet seldom feast on what I've found.
A mimic's voice, both sharp and sly,
A flash of blue when I take to the sky.
What am I?

A blanket grey, I cloak the sky,
With trailing streaks that seem to sigh.
I promise rain that won't descend,
As tears of mist drift in the wind.
What am I?

I'm found in flocks, a social breed,
In villages and fields I feed.
With a bare face, I call to peers,
A blackened bird with many years.
What am I?

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I Spy (animals)

Next we have a variety of animals for you to identify, from all around the world. You either know them or you don't.



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Songs

The following paragraphs are how the folks at the Natural History Museum describe several bird songs on their website. Can you figure out which British garden birds they're talking about?

_____ have a delicate song with warbling notes, whistles and clear pauses. It is sometimes written as 'twiddle-oo, twiddle-ee-dee, twiddle-oo twiddle'. In the autumn and winter, the song is soft and mournful, becoming clearer and more powerful in the spring and summer months. You're also likely to hear it making a 'tic' sound, often repeated over and over, which is one of its calls.

_____ have an iconic, high-pitched and squeaky 'see-saw-see-saw' song which makes it one of the easiest birds to identify by sound. Alternating between two notes of different pitch, it sounds a bit like a bicycle pump being used. It's often written as 'teacher, teacher'.

The calls of _____ range from a hard staccato 'tchack' or 'jack', to a slow persistent squawking sound. These birds are well adapted to living in urban areas, often nesting in chimneys and buildings.

_____ have a light and twittering song, with a rapid succession of notes that they can't seem to get out quite fast enough. Their call sounds a bit like 'tickle-it'.

_____ have one of the easier songs to identify. Although they have a varied repertoire, they repeat each of their short phrases up to three times before moving on to a completely different one, which no other common birds do. Their notes are confident, powerful and less mellow than those of a blackbird. You're most likely to hear _____ singing from March to July, but they sometimes begin singing much earlier, even in late autumn if it's mild.

Larvae

You may be familiar with the 'final forms' of everybody's favourite British butterflies and moths, but can you identify them from their larval forms?





Prints

Wildlife trackers need to recognise footprints in the mud or snow, so can you? Hint: all can be found in England.



1



2



3



4



5

Homes

Which British animals live in these homes?





I Spy (plants)

Identify this selection of plants from around the world.

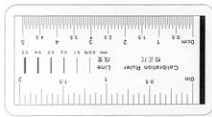




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Mystery objects

For each object, identify the part of the body and the species of animal. Providing a rough idea of the type of animal is probably enough if you're scoring yourself. These are tricky.



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Fossils

Can you identify the species and geological time period?





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Habitats

What are these habitats and where in the world are they?



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Tasty Fungi

Can you identify these edible mushrooms from their culinary guides?

1.

Taste: Mildly tangy and lemony with a strong resemblance to cooked chicken, featuring a light umami savouriness. The younger specimens are more tender and flavourful, while older ones can develop a slightly bitter aftertaste.

Texture: Firm, fibrous, and meaty, closely mimicking the texture of poultry when cooked.

Best Preparation: Sautéed, fried, or added to stews and stir-fries as a meat alternative.

2.

Taste: Mild and subtly sweet, with delicate anise-like undertones. Slightly briny, sometimes compared to shellfish. When cooked, the flavour deepens into a soft, nutty umami with hints of almond.

Texture: Soft and tender but with a slight chewiness, especially in the stem. Velvety and delicate when cooked, but can become slightly crispy when seared.

Best Preparation: Pan-fried or roasted to bring out its mild umami depth. Works well in stir-fries, soups, or grilled as a meat substitute. Absorbs flavour well, making it excellent in soy-based marinades or butter sauces.

3.

Taste: Robust and deeply savoury, often described as intensely umami. Has a smoky, almost garlicky undertone with a touch of earthiness. Dried specimens have an even stronger depth of flavour, with hints of soy sauce or aged wood.

Texture: Chewy and slightly fibrous, especially in the stems, which are usually too tough to eat. Becomes tender yet retains a pleasant bite when cooked properly.

Best Preparation: Best when seared, grilled, or added to broths for their intense umami contribution. Excellent in stir-fries, miso soup, ramen, or as a meat substitute in Asian dishes. Dried specimens are great for stocks, imparting a deep, smoky umami to sauces and stews.

4.

Taste: Deeply savoury, meaty, and earthy, with mild nutty and woody undertones. Has a slight hint of black pepper or mild bitterness, especially in the gills. The flavour intensifies with roasting, taking on a richer, almost beef-like quality.

Texture: Firm and dense, with a satisfying chew akin to steak. When grilled or roasted, it retains a juicy but firm bite, making it an excellent meat alternative.

Best Preparation: Grilled whole as a burger substitute, absorbing smoky and charred flavours. Sliced and roasted with olive oil, garlic, and herbs. Stuffed and baked with cheese, breadcrumbs, or meat fillings.

5.

Taste: Delicate yet vibrant, with a fruity, mildly peppery flavour. Often compared to apricots, it has a subtle sweetness that complements its mild earthy undertones. The flavour profile is bright and fresh, with hints of nuttiness and a slight savoury edge.

Texture: Firm yet tender, with a slightly spongy feel, especially in the cap. The texture is smooth and almost buttery when cooked, with a satisfying bite that doesn't turn mushy.

Best Preparation: Sautéed in butter or olive oil to bring out its natural sweetness and fruity undertones. Pairs wonderfully with cream-based sauces, pasta, and risottos. Excellent in soups, gravies, or served as a side dish to poultry or game meats. Its mild flavour makes it a great complement to other forest mushrooms, and it can also be dried for later use, which intensifies its flavour.

Faeces

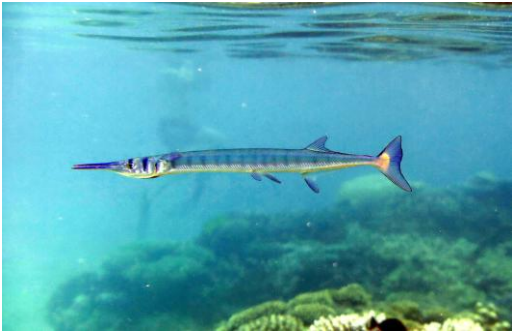
Which British animals are guilty of the following droppings?





Snouts

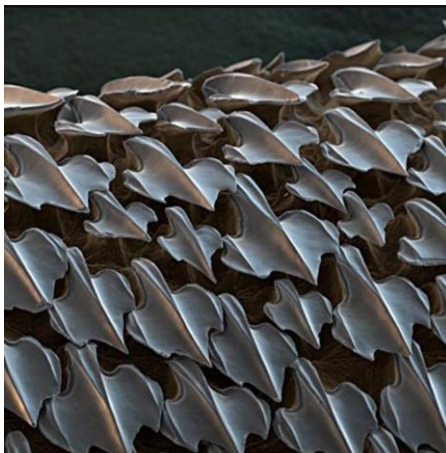
Can you name these animals with distinctive snouts?



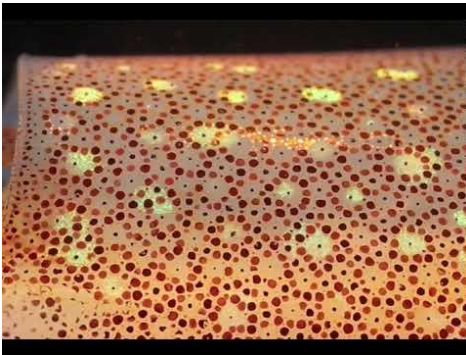


Magnified

What do these images show close up?



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CHAPTER 2: TAXONOMY

Classification, categorisation, and comparison are crucial to the study of the natural world. How are things related? How do things differ? What is a thing's lineage? These are our favourite questions, so you're not getting away with ignoring them in this quiz book.

Correct Order

Your next task is to put each one of these items in the correct order of the stated property.

(1) Date of discovery (earliest to latest)



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(2) Volume of voice (quietest to loudest)



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(3) Average altitude (lowest to highest)



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(4) Appearance of ancestors in the fossil record (earliest to latest)



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(5) Maximum height (shortest to tallest)



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Connections

What links the following groups?

(1)



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(2)



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(3)

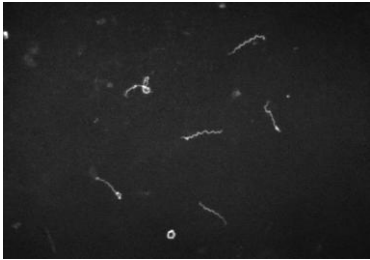
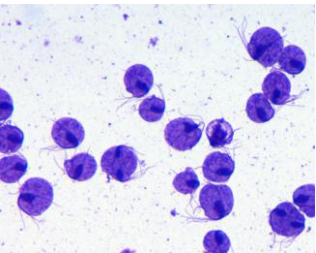
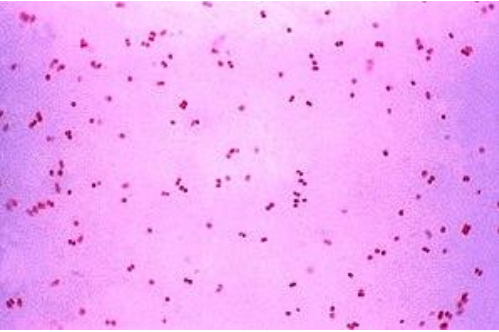


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(4)



(5)



Odd One Out

(1) Which one of the following mammals is the odd one out and why?

A



B



C



D



(2) Which of the following birds is the odd one out and why?

A



B



C



D



(3) Which one of the following minerals is the odd one out and why?

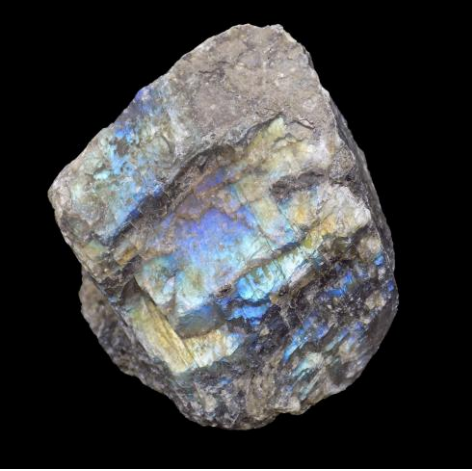
A



B



C



D



(4) Which of the following penguins is the odd one out and why?

A



B



C



D



(5) Which of the following plants is the odd one out and why?

A



B



C



D



Lineages

Can you pick the species most closely related to the one given?

(1)



A



B



C



D



(2)



A



B



C



D



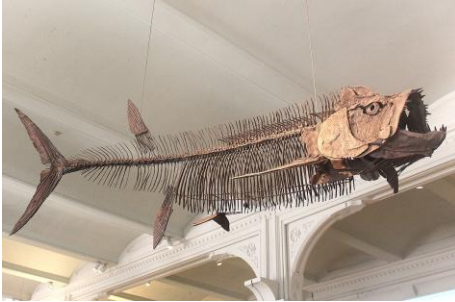
(3)



A



B



C



D



(4)



A



B



C



D



(5)



A



B



C



D



CHAPTER 3: TRIVIA

Now it's time to test your knowledge. We've got true and false, multiple choice, closest number, and all the quiz question types you could ask for. Is your brain full of interesting trivia? Or will you be left wishing you'd watched more Attenborough documentaries?

True or False

Palaeontology

1. You can tell the difference between a fossil and an ordinary rock by licking it.
2. The first step in the fossilisation process is the rapid burial of the corpse.
3. The most common fossils are ammonites.
4. Dinosaurs have been found preserved in amber, just like the mosquitoes of Crichton's *Jurassic Park*.
5. A well-preserved set of fossilised footprints discovered in Colorado appears to show a theropod doing a dance before slipping and falling.
6. *Tyrannosaurus* lived closer to the time of the moon landings than to *Stegosaurus*.

Ethology

7. Octopuses have been known to punch fish 'out of spite', rather than for hunting reasons.
8. Ostriches do indeed bury their heads in the sand when threatened by predators.
9. Crows enjoy sledding in the snow.
10. The dodo wasn't actually flightless; just really lazy.
11. Mother birds will reject their offspring if a human so much as touches the chicks.
12. Orcas appear to have their own fashion trends, and wear dead salmon as hats.

Humorous scientific names

13. *Turdus maximus* is a species of Tibetan thrush.
14. *Aha ha* is a species of Australian wasp.
15. *Blooble wooble* is a species of South Pacific shrimp.

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16. *Crikey steveirwini* is a species of Australian gecko.
17. *Ba humbugi* is a species of snail endemic to Christmas island.
18. *Vini vidivici* is a species of Pacific parrot that, ironically, can no longer be seen because it's extinct.

Mycology

19. Despite common misconceptions, all fungi are edible.
20. The evolution of white rot fungi stopped the production of new coal.
21. Three species of fungi have been isolated from Chernobyl— they use melanin to absorb the ionising radiation as an energy source.
22. Two species of fungi have been isolated from the vacuum of space, surviving in low-Earth orbit by forming hardy spores.
23. *Aspergillus fumigatus* is a species of fungi that symbiotically lives in human lungs, feeding on the dust that would otherwise clog our airways.
24. A mycorrhizal network is a web of fungal hyphae that connects the roots of all the trees in a woodland, allowing them to communicate, colloquially referred to as the 'wood wide web'.

25.

Bonus

26. Charles Darwin dropped out of medical school because he found the lectures boring.

Ornithology

This section is basically obligatory for a natural history book. So here's five questions and then we can talk about other things.

1. What does this finch eat?



- A. Seeds
- B. Insects
- C. Cactus
- D. Fruit

2. What does this kite eat?



- A. Worms
- B. Carrion
- C. Nectar
- D. Snails

3. To what order does this bird belong?



- A. Cuculiformes (cuckoos)
- B. Otidiformes (bustards)
- C. Ciconiiformes (storks)
- D. Accipitriformes (hawks)

4. Of what species is this skull?



- A. European herring gull (*Larus argentatus*)
- B. Jackass penguin (*Spheniscus demersus*)
- C. Great cormorant (*Phalacrocorax carbo*)
- D. Arctic skua (*Stercorarius skua*)

5. Who might this nest belong to?



- A. Willow warbler (*Phylloscopus trochilus*)
- B. Wood pigeon (*Columba palumbus*)
- C. Chaffinch (*Carduelis carduelis*)
- D. Long-tailed tit (*Aegithalos caudatus*)

Naturalists

1. Which 19th-century naturalist was one of the first to systematically classify insects and published an influential entomological book titled *Systema Naturae*?
2. Which naturalist was an early proponent of the theory of "ecological succession" and believed ecosystems naturally evolve over time?
3. Which botanist is credited with discovering photosynthesis?
4. Which naturalist described the concept of "convergent evolution" after studying the similar traits of unrelated animals like bats and birds?
5. Which naturalist is credited with discovering the phenomenon of mimicry in nature, particularly with butterflies imitating other species to avoid predators?
6. Which naturalist's study of the migration patterns of birds is often considered the starting point for modern ornithology?
7. Which naturalist discovered that honeybees communicate with one another through a "waggle dance," conveying information about food sources?
8. Which evolutionary biologist is known as the main proponent of the importance of symbiosis in evolution, as well as co-developing the Gaia hypothesis?

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9. Which naturalist is considered the first to record detailed accounts of the flora and fauna of the Amazon rainforest?
10. Which primatologist is best known for her groundbreaking work with mountain gorillas in Rwanda?

Anatomy and Physiology

I appreciate you're probably not a veterinarian or zoologist, but neither am I. In any case, you'll hopefully find this interesting. I tried to avoid this book becoming too nerdy, so this is the compromise: ten questions. Good luck.

1. Sea cucumbers have yellow blood because, instead of haemoglobin, they produce:
 - A. Haemocyanin, containing copper.
 - B. Chlorocruorin, containing iron.
 - C. Haemerythrin, containing iron.
 - D. Vanabin, containing vanadium.

2. Uricotelic organisms are those that excrete nitrogenous waste as uric acid, so which of the following animals are uricotelic?
 - A. Birds
 - B. Primates
 - C. Jellyfish
 - D. Sharks

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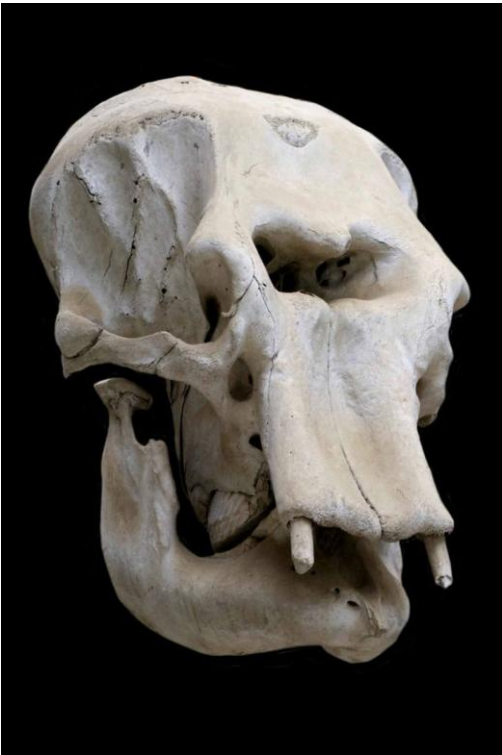
3. We all know the human heart is four-chambered, but which of the following animals have two-chambered hearts?
- A. Amphibians
 - B. Bony Fish
 - C. Reptiles
 - D. Birds
4. The eyes of which of these animals contains a bony ring within the sclera?
- A. Dogs
 - B. Squid
 - C. Turtles
 - D. Dragonflies
5. Frogs' hearts stop beating completely when they freeze solid in the Winter, in a strange type of hibernation. They survive by flooding their blood with what?
- A. Glucose
 - B. Sodium chloride
 - C. Albumin
 - D. Calcium carbonate

6. In birds, which one of the following feather colours is formed not by pigments, but by an optical effect called Tyndall's phenomenon?
- A. Red
 - B. Yellow
 - C. Green
 - D. Blue
7. The largest known neurone in the animal kingdom belongs to:
- A. Squid
 - B. Crabs
 - C. Primates
 - D. Whales
8. Instead of circulating blood for carrying oxygen and nutrients, insect bodies contain a fluid called haemolymph for the same purpose, which has many other functions but **never** what, as far as we know?
- A. Squirting at enemies to cause stinging burns
 - B. Exuding it to form bridges across tree branches
 - C. Pumping into wings after metamorphosis to inflate them via hydrostatic pressure
 - D. Gifting to females during copulation

9. In homeothermic animals, raising the body's ambient temperature is a way to reduce the survival of disease-causing microorganisms in the blood, known as 'fever', but what do ectothermic ('cold-blooded') animals do instead?
- A. Accept increased mortality rates from infectious diseases
 - B. Move themselves into hotter areas to warm up
 - C. Vibrate their limbs to generate heat from increased muscular activity
 - D. Tolerate microorganisms in their blood, while restricting their growth enough to prevent disease
10. Which of these is **not** an example of counter-current exchange?
- A. Gas exchange in fish gills
 - B. Heat exchange in bird legs
 - C. Salt exchange in reptilian skin
 - D. Water exchange in mammalian kidneys

Cryptozoology

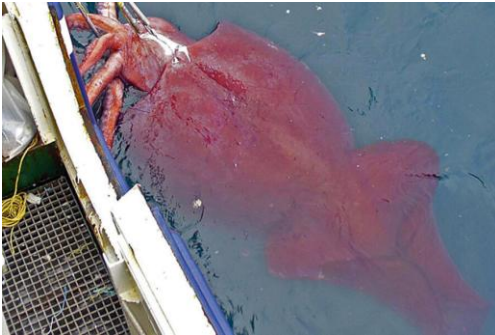
1. This is the skull of what animal?
2. What did the ancient Greeks probably think it was?



3. What is this animal?
4. What mythological creature might it be responsible for?



5. What is this animal?
6. What did sailors probably think it was?



7. What is this animal (washed up on a beach)?
8. What myth might it have been responsible for?



9. What is this animal?
10. Sightings of it gave rise to what folktale?



Darwin's Puzzles

1. Which bird did Darwin regard as his 'torture' because of its tail feathers?
2. Why did ants (and other eusocial insects) present a problem for the theory of natural selection?
3. Darwin called the evolution of what organisms an 'abominable mystery'?
4. What was Darwin's theory of 'pangenesis' and what did he think it explained?
5. Why did physicists, most famously Lord Kelvin, think Darwin's theory of natural selection was wrong?

Mineralogy

I did call it 'Bones and Stones', so what about those stones then?

1. What is the most common mineral in the Earth's mantle, by volume?
 - A. Olivine
 - B. Pyroxene
 - C. Bridgmanite
 - D. Peridotite

2. Which mineral is a polymorph of carbon that forms under extremely high pressure but at relatively low temperatures?
 - A. Graphite
 - B. Lonsdaleite
 - C. Moissanite
 - D. Fullerene

3. Which mineral is the primary component of tooth enamel?
 - A. Hydroxylapatite
 - B. Fluorite
 - C. Apatite
 - D. Calcite

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4. What rare boron silicate mineral exhibits trichroism, displaying one of three colours depending on the angle of light?
- A. Spodumene
 - B. Andalusite
 - C. Axinite
 - D. Iolite
5. Which mineral may contain helium atoms trapped within its crystal lattice, produced by radioactive decay?
- A. Zircon
 - B. Beryl
 - C. Fluorite
 - D. Apatite

Numbers

This is natural history in numbers!

1. How many known species of extant monotremes exist?
2. How many walking legs do decapod crustaceans typically have?
3. In what year was Carl Linnaeus' *Systema Naturae* first published?
4. How many pairs of appendages do chelicerates possess?
5. How many ammonite species went extinct at the end of the Cretaceous period? (Estimate in thousands)
6. What is the diploid chromosome number of a fruit fly (*Drosophila melanogaster*)?
7. How many pairs of gill arches did primitive jawless fish have?
8. What is the basal metabolic rate of a human in kilocalories per day (rounded average)?
9. How many millions of years ago did the Cambrian explosion occur?
10. How many extant species of tuatara (*Sphenodon*) are recognised?
11. How many days does it take for a chicken egg to hatch?
12. How many legs do isopods have?
13. How many known species of coelacanths are alive today?
14. How many chambers does a bird's stomach have?
15. What is the maximum recorded age of a Greenland shark (in years)?
16. How many lenses are in a horseshoe crab's

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- compound eyes (per eye)?
17. How many species of velvet worms (*Onychophora*) are currently recognised?
 18. What is the number of toes on an ostrich's foot?
 19. How many millions of years ago did the first tetrapods crawl onto land?
 20. How many species of axolotl exist in the wild?

Alpines

All sorts of strange things live in alpine climates, i.e. on mountains between the tree line and the snow line.

1. Which pigment, responsible for red and purple hues, also protects alpine plants from UV radiation?
2. Why do many alpine plants grow in cushion-like formations?
3. Which bird species is known for its high-altitude migrations over the Himalayas, reaching elevations up to 29,000 feet?
4. Which reptile is known to inhabit alpine environments, and what adaptation allows it to survive in such cold climates?
5. What morphological adaptation helps alpine insects, such as certain grasshoppers, absorb more heat in cold environments?
6. Which insect is known for its high-altitude pollination activities in the Alps, often found at elevations between 1,600 and 3,100 meters?
7. Which amphibian species is considered an indicator of environmental health in alpine ecosystems?
8. Which microbe is responsible for the formation of the red “watermelon snow” in alpine regions?
9. What adaptation helps alpine marmots (*Marmota marmota*) survive the cold winters at high altitudes?
10. Which alpine bird species changes its plumage colour seasonally to maintain camouflage?

SOLUTIONS

Chapter 1: ID

Riddles

The clue was in the preamble: these are all clouds, mosses, or corvids.

1. Cirrus vertebratus (Ci ve)
2. Magellan's sphagnum (*Sphagnum magellanicum*) — accept any Sphagnum to be honest
3. Eurasian jay (*Garrulus glandarius*)
4. Nimbostratus virga (Ns vir)
5. Rook (*Corvus frugilegus*)

I Spy (animals)

1. Sooty tern (*Onychoprion fuscatus*)
2. Cat gecko (*Aeluroscalabotes felinus*)
3. Filbert weevil (*Curculio occidentis*)
4. Cookiecutter shark (*Isistius brasiliensis*)
5. Fennec fox (*Vulpes zerda*)

Songs

1. Robin (*Erithacus rubecula*)
2. Great tit (*Parus major*)
3. Jackdaw (*Coloeus monedula*)
4. Goldfinch (*Carduelis carduelis*)
5. Song thrush (*Turdus philomelos*)

Larvae

1. Red admiral butterfly (*Vanessa atalanta*)
2. Holly blue butterfly (*Celastrina argiolus*)
3. Peacock butterfly (*Aglais io*)
4. Garden tiger moth (*Arctia caja*)
5. Black arches moth (*Lymantria monarcha*)

Prints

1. Fox (*Vulpes vulpes*)
2. Otter (*Lutra lutra*) – notice the webbed digits
3. Domestic dog (*Canis familiaris*)
4. Badger (*Meles meles*) – notice the fifth toe print
5. Domestic cat (*Felis catus*) – notice the lack of claws as they are retractile

Homes

1. Sand martin (*Riparia riparia*)
2. Badger (*Meles meles*)
3. Barn swallow (*Hirundo rustica*)
4. Solitary ground-nesting bees. Contrary to popular perceptions, the majority of British bees nest in the ground. Can't identify the exact species from this photograph.
5. Field vole (*Microtus agrestis*)

I Spy (plants)

1. Giant hog weed (*Heracleum mantegazzianum*)
2. Dragon blood tree (*Dracaena cinnabari*)
3. Living stones (*Lithops spp.*) — there are 37 species, not expecting you to identify them all.
4. Doll's eye (*Actaea pachypoda*)
5. Giant water lily (*Victoria cruziana*)

Mystery objects

1. Gill rakers of the basking shark (*Cetorhinus maximus*)
2. Baculum (os penis) of the sloth bear (*Melursus ursinus*)
3. Shell of the common piddock (*Pholas dactylus*)
4. Sternum of the American white pelican (*Pelecanus erythrorhynchos*)
5. Egg case ('mermaid's purse') of the Port Jackson shark (*Heterodontus portusjacksoni*)

Fossils

1. 'Thagomizer' (tail bones) of *Stegosaurus stenops*, Jurassic
2. Giant dragonfly (*Meganeura monyi*), Carboniferous
3. American crinoid (*Agaricocrinus americanus*), Carboniferous
4. Paddle (fin) of Ichthyosaur (*Stenopterygius quadriscissus*), Jurassic
5. Sea scorpion (*Eurypterus remipes*), Silurian

Habitats

1. Lagoon in Gunung Gede National Park, Java, **Indonesia** — an amazingly biodiverse rain-forest atop a volcano.
2. Mono Lake, a saline soda lake in Mono County, **California**, USA (note the characteristic Tufa towers)— home of extremophile bacteria that consume arsenic.
3. RSPB Bempton Cliffs, Yorkshire, **England** (each one of those white dots is a nesting seabird) — one of England’s best nature reserves.
4. Laguna Colorada, a shallow salt lake in **Bolivia**, listed as a “Ramsar Wetland of International Importance”. Those birds are Andean flamingos (*Phoenicoparrus andinus*). The other clue, apart from the Andes mountains, is the white islands composed of borax.
5. Jingmaham living root bridge, Mawlynnong, Meghalaya, **India**. These living bridges are constructed from rubber fig trees (*Ficus elastica*) and take 15 years to become fully functional. Some are said to be hundreds of years old but all need active care to keep them usable.

Tasty Fungi

1. Chicken of the woods (*Laetiporus sulphureus*)
2. Oyster (*Pleurotus ostreatus*)
3. Shiitake (*Lentinula edodes*)
4. Portobello (*Agaricus bisporus*)
5. Yellow chanterelle (*Cantharellus cibarius*)

Faeces

1. Bat (cannot identify species from picture)
2. Rabbit (*Oryctolagus cuniculus*) droppings on the left, brown hare (*Lepus europaeus*) droppings on the right
3. Hedgehog (*Erinaceus europaeus*)
4. Otter (*Lutra lutra*)
5. Trick question! Not faeces. These are owl pellets (regurgitated undigested parts of prey)

Snouts

1. Black and rufous elephant shrew (*Rhynchocyon petersi*)
2. Crocodile needlefish (*Tylosurus crocodilus*)
3. Pig-nosed turtle (*Carettochelys insculpta*)
4. Star-nosed mole (*Condylura cristata*)
5. Saiga antelope (*Saiga tatarica*)

Magnified

1. Shark skin (dermal denticles)
2. Butterfly wing scales
3. African bush elephant skin
4. Peacock feather
5. Squid skin (discoid units of chromatophores)

Chapter 2: Taxonomy

Correct Order

1. Giant squid (picture 2, *Architeuthis dux*, **1856**), Okapi (picture 4, *Okapi johnstoni*, **1901**), Bonobo (picture 5, *Pan paniscus*, **1928**), Coelacanth (picture 3, *Latimeria chalumnae*, **1938**), Megamouth shark (picture 1, *Megachasma pelagios*, **1976**).
2. Howler monkey (picture 2, *Alouatta spp.*, **90 dB**), Lion (picture 1, *Panthera leo*, **114 dB**), Rooster (picture 3, *Gallus gallus domesticus*, **130 dB**), Greater bulldog bat (picture 5, *Noctilio leporinus*, **140 dB**), Sperm whale (picture 4, *Physeter macrocephalus*, **230 dB**).
3. Stratocumulus (picture 2, **0.5–2 km**), Nimbostratus (picture 4, **0.5 – 3 km**), Altocumulus (picture 1, **2–6 km**), Altostratus (picture 5, **2–7 km**), Cirrus (picture 3, **6–12 km**).
4. Jellyfish (picture 5, 560 million years ago, **Precambrian**), Nautilus (picture 2, 480 million years ago, **Ordovician**), Cockroach (picture 4, 300 million years ago, **Permian**), Crocodile (picture 3, 240 million years ago, **Triassic**), Salamander (picture 1, 150 million years ago, **Jurassic**). Correct at the time of publication (2025).
5. Cowslip (picture 3, *Primula veris*, **30 cm**), Oxeye daisy (picture 4, *Leucanthemum vulgare*, **1 m**), Rowan (picture 1, *Sorbus aucuparia*, **15 m**), British oak (picture 5, *Quercus robur*, **40 m**), Douglas fir (picture 2, *Pseudotsuga menziessi*, **60 m**).

Connections

1. **Ancient Egyptian deities.** Pictures in order: Bast was cat-headed, Sobek was crocodile-headed, Thoth was ibis-headed, and Anubis was jackal-headed.
2. **Classes of the Echinodermata Phylum.** The first picture is a starfish (Class: Asteroidea), the second picture is a sea cucumber (Class: Holothuroidea), the third picture is a sea lily (Class: Crinoidea), and last is a sea urchin (Class: Echinoidea). Do not award yourself any points if you thought the answer was they're all sea creatures.
3. **Model organisms** (i.e. those widely used for biological research, particularly genetics, by virtue of a short generation time, being easy to care for, and possessing relevant similarities to human biology, among other useful traits). Pictures in order: Fruit fly (*Drosophila melanogaster*), Mouse (*Mus musculus*), Zebrafish (*Danio rerio*), and Thale cress (*Arabidopsis thaliana*). Microorganisms, although also commonly employed, couldn't be included here because good luck identifying *Escherichia coli* from a micrograph.
4. **Famous fossil sites.** Pictures in order: Hell creek formation, Montana, USA (where *Tyrannosaurus* was first discovered); Jurassic Coast (the cliffs of Charmouth and Lyme Regis), Dorset, England (where ichthyosaurs were first discovered); Burgess Shale, Canadian Rockies of British Columbia, Canada (exceptionally preserved Cambrian fossils); and Kem Kem beds, Morocco. The big clue here is how every picture looks a bit like a quarry.

5. **Pathogens of sexually transmitted infections.** Pictures in order: Pubic louse (*Phthirus pubis*), Gonorrhoea (*Neisseria gonorrhoeae*, a gram-negative diplococcus bacterium), Trichomoniasis (*Trichomonas vaginalis*, a flagellated protozoan best seen with the Giemsa stain), and Syphilis (*Treponema pallidum*, a spirochaete best seen with high-contrast dark-ground microscopy).

Odd One Out

1. **D.** In order, the pictured mammals are the Sunda slow loris (*Nycticebus coucang*), European mole (*Talpa europaea*), Hispaniolan solenodon (*Solenodon paradoxus*), and the Indian pangolin (*Manis crassicaudata*). The only one of these mammals that isn't venomous is the pangolin. This question is a nice bit of trivia— read about venomous mammals! And yes moles do have toxic saliva, for paralysing earthworms, although it wouldn't do you much harm.
2. **C.** In order, the pictured birds are the American osprey (*Pandion haliaetus*), Western barn owl (*Tyto alba*), Eastern yellow robin (*Eopsaltria australis*), and blue-and-yellow macaw (*Ara ararauna*). All have zygodactyl feet except for the robin, which has anisodactyl feet like most songbirds (as you can see in the picture provided). Note how taxonomy is more important for answering this question than being able to accurately identify the exact species (e.g. it's enough to know that the owl is an owl,

- rather than the exact species of barn owl)
- 3. A.** In order, the pictured minerals are fluorite, tiger's eye, labradorite, and tourmaline. All examples except fluorite are exhibiting chatoyancy, an iridescence-like optical reflectance effect. The pictures are almost enough without knowing much about the minerals themselves.
 - 4. B.** In order, the pictured penguins are the emperor (*Aptenodytes forsteri*), Galapagos (*Spheniscus mendiculus*), gentoo (*Pygoscelis papua*), and macaroni (*Eudyptes chrysolophus*). The Galapagos penguin is the only penguin found North of the equator. It's also the only one named after a geographical location. There are only 18 species of penguin so this question was hopefully not too difficult.
 - 5. D.** In order, the pictured plants are toothwort (*Lathraea squamaria*), maidenhair spleenwort (*Asplenium trichomanes*), lungwort (*Pulmonaria officinalis*), and borage (*Borago officinalis*). As is clear from their names, all except borage are a 'wort' (from the Old English *wyrt* for 'root') for a body part i.e. a plant traditionally held to possess medicinal properties specifically for complaints regarding that particular body part.

Lineages

- 1. D.** Pictured is the *Deinonychus*, in the family Dromaeosauridae. The pictures, in order: *Ramphorynchus* (a pterosaur), *Allosaurus*,

Archaeopteryx (this answer is a close second), and *Microraptor* (also a Dromaeosaur and therefore the answer).

2. A. Pictured is the red wood ant (*Formica rufra*), in the order Hymenoptera. Ant mimicry is so common in nature, it has a name: myrmecomorphy. So pay attention to morphology! The pictures, in order: Tarantula hawk wasp (*Hemipepsis ustulata*), red weaver-ant mimicking jumper spider (*Myrmaplata plataleoides*), spiny leaf insect, freshly hatched (*Extatosoma tiatarum*), and the flesh fly (*Sarcophaga bercaea*).
3. C. Pictured is the spotted gar (*Lepisosteus oculatus*). Fossils pictured, in order: *Knightia* (an Eocene clupeid, the most commonly excavated fossil fish in the world), *Xiphactinus* (Cretaceous predatory fish from an extinct order), *Masillosteus* (an Eocene gar), and the *Hybodus* (a Mesozoic shark).
4. A. Pictured is a *Magnolia grandiflora*, a eudicot (apart from the answer, the rest are monocots). Pictured, in order: cinnamon (*Cinnamomum verum*), vanilla (*Vanilla planifolia*), saffron (*Crocus sativus*), and lemongrass (*Cymbopogon citratus*).
5. B. Pictured is the garden earthworm (*Lumbricus terrestris*), an Annelid of the Class: Clitellata. Pictured, in order: bobbit worm (*Eunice aphroditois*, a polychaete), medicinal leech (*Hirudo medicinalis*), sand worm (*Alitta virens*, a polychaete), and beef tapeworm (*Taenia saginata*, not even an Annelid, actually a Platyhelminth).

Chapter 3: Trivia

True or False

Palaeontology

1. **True.** Fossilisation tends to preserve remnants of a bone's honeycomb-like internal structure. This porosity is why a fossil bone will stick to your tongue slightly if you lick it. Probably best to look for the honeycomb structure using a magnifying glass though.
2. **False.** The first thing an organism must do to be fossilised is die.
3. **False.** The most common animal fossil across all collections is probably the snail, *Turritella*. Perhaps more common though are chondrites i.e. trace fossils of burrows and other imprints. The most common fossils of all may well be single cell marine invertebrates: foraminifera, diatoms, and radiolaria – so common they form the basis for the diatomaceous earth used in our gardens. Whichever way you look at it, however, the answer is not ammonites.
4. **True.** Most famously (at the time of publication), a feathered dinosaur tail preserved in amber was discovered in Myanmar. However, there are rumours of whole dinosaurs preserved this way in private collections. Unfortunately, the most amazing fossils, with the most to teach us, are also likely locked up in private collections.
5. **False.** There is evidence of dinosaurs dancing, such as an abundance of scrape marks at several

Cretaceous fossil sites in Colorado, which analysis suggests are probably traces of theropod courtship rituals. However, nobody has ever discovered evidence of a courtship ritual gone wrong.

6. **True.** *Stegosaurus* lived in the Jurassic period, which preceded the Cretaceous period.

Ethology

7. **True.** This behaviour was first documented in a 2024 study of hunting groups of *Octopus cyanea*.
8. **False.** This is a myth first perpetuated by Pliny the Elder in ancient Rome. Ostriches, when threatened, either run away or flop on the ground to hide among vegetation.
9. **True.** You can even watch it on Youtube: crows often use things like jar lids as a sled to ride down a snow-covered roof, then climb back up to the top and do it again.
10. **False.** Their wings were too small to generate enough lift.
11. **False.** This is a common myth that's easy to disprove. Birds tend not have a good sense of smell, so wouldn't be able to tell if a human had handled their chicks.
12. **True.** Orcas (*Orcinus orca*) were first spotted wearing dead salmon on their heads in 1987, although the phenomenon was short-lived. However, it was spotted again in 2024, so it seems to have come back into fashion. Nobody is sure why they do this, but scientists wonder if this is a way of stashing food for consumption at a later date, or a way to display high food availability, since orcas have also been observed stashing fish under their pectoral fins at similar

times.

Humorous scientific names

13. **True.** Easy one to start you off.
14. **True.**
15. **False.** I made it up.
16. **False.** It's actually an Australian land snail.
17. **False.** It's named *Ba humbugi* because it was discovered in the Ba district, Fiji. The discoverer, Alan Solem, therefore couldn't help himself.
18. **True.** Annoyingly, the actual Latin phrase is '*veni vidi vici*' (I came, I saw, I conquered), but we'll let them have the joke anyway.

Mycology

19. **True.** Some are only edible once. I couldn't resist this old joke.
20. **True.** Before white rot fungi evolved to break down lignin, nothing could decompose a dead tree. The accumulation of dead trees in the Carboniferous period therefore fossilised and became coal. Now we have such fungi, new coal cannot be produced.
21. **True.**
22. **False.** However, experiments on the International Space Station have demonstrated that fungi of the species, *Aureobasidium pullulans*, adhered to cotton wool, can survive in open space for two years.
23. **False.** You really do not want *Aspergillus* in your lungs. Invasive pulmonary aspergillosis has a mortality ranging from 35 to 90%. Even asymptomatic colonisation (usually in people with

chronic obstructive airway disease) can lead to clinical disease.

24. **True.**

Bonus

25. **True.** Darwin wished to follow in his footsteps of his father. Unfortunately, he hated the sight of blood and found the lectures boring so he dropped out of Edinburgh medical school and decided to study divinity at Cambridge.

Ornithology

1. **C.** It's the common cactus-finch (*Geospiza scandens*). Inspect the beak.
2. **D.** It's the snail kite (*Rostrhamus sociabilis*). The hook-shaped beak is for winking snails.
3. **A.** It's the greater road-runner (*Geococcyx californianus*), also known as the ground cuckoo.
4. **B.**
5. **A.**

Naturalists

1. **Carl Linnaeus**, famous for developing the binomial nomenclature system for naming species, which included insect classification
2. **Henry David Thoreau**, although primarily known for his philosophical writings, also observed and wrote about ecological succession in the context of his studies in the wilds of Massachusetts.
3. **Jan Ingenhousz**, a Dutch-British physiologist and naturalist who also discovered that plants have cellular respiration, like animals.
4. **Alfred Russel Wallace**, a contemporary of Darwin, independently developed the concept of evolution and studied convergent evolution among different species.
5. **Henry Walter Bates**, famous for discovering Batesian mimicry in butterflies, whereby harmless species imitate toxic or dangerous species for protection.
6. **John James Audubon**, best known for one of the finest ornithological works of all time, *The Birds of America*, as well as discovering many new species himself.
7. **Karl von Frisch**, who received the Nobel prize in Physiology or Medicine in 1973, for his achievements in comparative behavioural physiology and pioneering work in communication between insects.
8. **Lynn Margulis**, known for her work on the symbiotic theory of evolution, particularly her research into endosymbiosis and the idea that cooperation between species can drive evolutionary changes.

9. **Alexander von Humboldt**, a German polymath and explorer often considered the “father of ecology”, with numerous places and species named after him.
10. **Dian Fossey**, now most well known for her book, *Gorillas in the Mist*, adapted into a film of the same name.

Anatomy and Physiology

1. **D.** Haemocyanin results in the blue blood of cephalopods and spiders. Chlorocruorin gives leeches and some marine worms their green blood. Haemerythrin gives some other marine worms purple blood.
2. **A.** Birds excrete a white paste of uric acid, hopefully not on your shoulder. Jellyfish are ammonotelic (they excrete nitrogenous waste as ammonia in a dilute urine), and the rest are ureotelic (excreting nitrogenous waste as urea in a more concentrated urine).
3. **B.** Fish have two-chambered hearts i.e. one atrium and one ventricle. Although they also have two smaller almost-chambers (the sinus venosus and bulbus arteriosus), these are continuous with the atrium and ventricle, respectively, so aren't considered separate chambers in their own right. Amphibian hearts have three chambers. Reptilian hearts also have three chambers (although an incomplete ventricular septum almost makes it four). The exception to this is the crocodilian heart, in which the ventricular septum is complete such that there are four chambers. Birds have four chambered

hearts like mammals.

4. **C.** The sclerotic ring is a ring of bone within the sclera (colloquially, 'the whites') of the eye, for structural support. Squid don't have any bones at all, so that can't be the answer. And the eyes of insects don't have a sclera, so can't contain a sclerotic ring. Last, mammalian eyes don't have sclerotic rings so the answer can't be dogs.
5. **A.** Glucose acts as an antifreeze, preventing ice crystals forming in the animal's cells which would otherwise cause irreversible injury. This problem is currently one of the main barriers to perfecting cryogenic sleep for humans.
6. **D.** Blues and whites in bird plumage are usually 'structural colours', formed by schemochromes, which are nanostructures that produce colour through optical interference, rather than via pigments. This phenomenon is not unique to birds, and is most famously found in butterfly wings too.
7. **A.** The squid giant axon controls part of the jet propulsion system in squid, and has the largest diameter of any axon (i.e. the fibre part of a neurone) in the animal kingdom. This provided a great experimental advantage for Hodgkin and Huxley as it allowed them to insert voltage clamp electrodes inside the lumen of the axon. Their Nobel prize-winning work massively increased our understanding of neurone physiology.
8. **B.** The other answers are true. Blister beetles (Family: Meloidae) produce cantharidin in their haemolymph, which is a blistering agent. Newly hatched butterflies and moths pump up their wings with their haemolymph. In many species of cricket, the male

offers a specialised spur to the female to chew on during copulation, to provide a haemolymph gift, although the purpose of this is not yet fully understood. As for the answer, it's difficult to see how haemolymph could ever be used as a bridge because a propensity to solidify would negatively interfere with all other functions of haemolymph. Although haemolymph can clot, like blood, this is to seal wounds as a temporary measure, as in any other animal, and would not provide enough structural support to bear the animal's weight.

9. **B.** This is called 'behavioural fever' and is well documented in reptiles, most notably marine iguanas. However, bats do something similar to answer D. Humans often do something similar to answer C (rubbing our hands together).
10. **C.** Counter-current exchange is the use of two flowing bodies flowing in opposite directions to match up the concentration gradients for optimal exchange of some property. The answer is C because reptiles (as well as seabirds and elasmobranchii) have specialised salt glands for excreting sodium chloride via active transport, typically located in the nostrils or tongue. This salt is then excreted by sneezing. Unlike human kidneys, reptilian kidneys don't make use of counter-current exchange as their nephrons don't have a loop of Henle, meaning they can't produce concentrated urine. Avian kidneys are only slightly more developed. However, blood vessels in bird legs are configured for counter-current exchange of heat, since they are among their only body parts not covered by feathers.

Cryptozoology

1. Cretan dwarf mammoth (*Mammuthus creticus*)
2. Cyclops
3. West Indian Manatee (*Trichechus manatus*)
4. Mermaid
5. Colossal squid (*Mesonychoteuthis hamiltoni*)
6. Kraken
7. Giant oarfish (*Regalecus glesne*)
8. Sea serpent. As the longest bony fish known to science, this makes it the most probable cause of the sea serpent myth.
9. Himalayan brown bear (*Ursos arctos isab ellinus*)
10. Yeti. Genetic analyses of supposed yeti artefacts show that the yetis are misidentified bears of many species.

Darwin's Puzzles

1. **Peacock.** Darwin said, "The sight of a feather in a peacock's tail, whenever I gaze at it, makes me feel sick." After all, an animal that grows such an impractical ornament should surely have gone extinct, no? Many biologists now think this is precisely why peacock males grow such large and beautiful tail feathers: surviving with such a handicap is a prominent display of fitness to the opposite sex. This is known as the handicap principle.
2. **Kin selection.** Darwin said, "I...will confine myself to one special difficulty, which at first appeared to me insuperable, and actually fatal to my whole theory. I allude to the neuters or sterile females in insect communities: for these neuters often differ widely in instinct and in structure from both the male and fertile females, and yet from being sterile they cannot propagate their kind." His solution was 'selection of the family', which later gave rise to the theory of kin selection and evolutionary explanations for altruism itself.
3. **Angiosperms.** The rapid rise and diversification of the angiosperms— the flowering plants. This is regarded as one of the greatest adaptive radiations of all time, and happened suddenly in the Cretaceous period (100 million years ago). Darwin wrote, "the rapid development as far as we can judge of all the higher plants within recent geological times is an abominable mystery." Today, biologists still don't know for sure but believe pollinators are probably

part of the answer.

4. **A theory of heredity.** One problem for Darwin was how organisms actually inherited characteristics from the previous generation. His solution was to propose the theory that every cell in the body sheds minute particles of inheritance, called 'gemmules', which then congregated in the reproductive organs. These gemmules could be modified by the organism's environment, explaining evolution. We now know the true mechanism of inheritance thanks to Gregor Mendel and the work that followed: genetics.
5. **The age of the Earth.** Lord Kelvin estimated the Earth was about 100 million years old and certainly no more than 200 million years old. This was nowhere near long enough for natural selection to have resulted in the diversity of life we see today. Darwin replied, "With respect to the lapse of time not having been sufficient since our planet was consolidated for the assumed amount of organic change, and this objection, as urged by [Lord Kelvin], is probably one of the gravest as yet advanced, I can only say, firstly that we do not know at what rate species change as measured in years, and secondly that many philosophers are not yet willing to admit that we know enough of the constitution of the universe and of the interior of our globe to speculate with safety on its past duration." Darwin was correct. The subsequent discovery of radioactivity allowed scientists to calculate the ages of rocks. We now believe the Earth to be around 4.5 billion years old.

Mineralogy

1. **C.** One of a group of silicates known as silicon perovskites, these minerals are not stable at the Earth's surface so can only be found deep in the mantle.
2. **B.** Lonsdaleite, also known as hexagonal diamond, is a polymorph of carbon formed under high-pressure conditions, typically associated with meteorite impacts.
3. **A.** Hydroxylapatite (a form of calcium phosphate) is the main mineral that makes up tooth enamel, giving it hardness and durability.
4. **D.** Iolite, also known as cordierite, displays strong pleochroism, showing different colours when viewed from different angles.
5. **A.** Zircon, the mineral form of zirconium (IV) silicate, can contain helium atoms within its crystal structure, resulting from the radioactive decay of uranium and thorium impurities over geological time.

Numbers

1. 5 — There are five extant species of monotremes (4 echidnas, 1 platypus).
2. 8 — Trick question! Decapod crustaceans have 10 legs, but 8 are typically used for walking.
3. 1735
4. 6 — Chelicerates (like spiders and scorpions) have six pairs of appendages: 1 pair of chelicerae, 1 pair of pedipalps, and 4 pairs of legs.
5. 30,000 — Roughly 30,000 ammonite species are estimated to have gone extinct during the K-Pg extinction event.
6. 8 — The diploid chromosome number for *Drosophila melanogaster* is 8 (4 pairs).
7. 7 — Primitive jawless fish had around seven pairs of gill arches, though it varied.
8. 1,500–1,800 — The average human basal metabolic rate is about 1,500–1,800 kilocalories per day, depending on body size and composition.
9. 541
10. 2 — There are two recognised extant species of tuatara (*Sphenodon punctatus* and *Sphenodon guntheri*).
11. 14 — Isopods possess 14 legs, arranged in seven pairs.
12. 21
13. 2 — The two extant species are *Latimeria chalumnae* (West Indian Ocean coelacanth) and *Latimeria menadoensis* (Indonesian coelacanth).

14. **2** — Birds possess a two-part stomach consisting of the proventriculus (glandular stomach) and the gizzard (muscular stomach).
15. **400** — Greenland sharks (*Somniosus microcephalus*) are among the longest-living vertebrates, with some individuals estimated to be centuries old.
16. **1000** — Each compound eye of a horseshoe crab comprises around 1,000 individual units known as ommatidia.
17. **200**
18. **2** — Ostriches (*Struthio camelus*) are unique among birds for having only two toes on each foot.
19. **360** — The earliest tetrapods are believed to have made the transition from water to land during the Late Devonian period.
20. **1** — The axolotl (*Ambystoma mexicanum*) is native to lakes near Mexico City, primarily Lake Xochimilco. In the wild, they are critically endangered due to habitat loss and pollution.

Alpines

1. **Anthocyanins.**
2. A cushion plant is a low-growing, tightly packed plant that forms a cushion-like shape. **This growth form is more aerodynamic** and therefore minimises exposure to wind and cold, retaining heat and reducing water loss.
3. **The bar-headed goose** (*Anser indicus*) is renowned for its migratory flights over the Himalayas, reaching altitudes where oxygen levels are significantly reduced.
4. **The viviparous lizard** (*Zootoca vivipara*) is found in alpine regions and has adapted to cold climates by giving birth to live young instead of laying eggs, allowing for better survival rates in cooler temperatures.
5. **Melanism**, or darker body coloration, helps alpine insects absorb more solar radiation, aiding in thermoregulation in cold environments.
6. **The alpine bumblebee** (*Bombus alpinus*) is a key pollinator in alpine regions, frequently found at elevations between 1,600 and 3,100 meters.
7. **The alpine salamander** (*Salamandra atra*), as it is sensitive to habitat and environmental changes.
8. The red algae *Chlamydomonas nivalis*.
9. They **hibernate** for up to seven months, entering a deep torpor to conserve energy.
10. **The rock ptarmigan** (*Lagopus muta*) molts its feathers seasonally, displaying white plumage in winter to blend with snow and brown mottled plumage in summer to match the tundra landscape.

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About the Author

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