



PART 1

Read the text below and answer questions 1–13.

SYMBIOSIS: THE WEB OF LIFE

A

In biology, symbiosis refers to close and persistent interactions between organisms of different species. These relationships are often described using three labels—mutualism, commensalism, and parasitism—but in practice they are not static boxes. Many partnerships fall along a continuum that can shift with season, life stage, or environmental conditions. A microbe that is helpful when food is scarce may become costly when nutrients are plentiful; a relationship that begins as facultative (beneficial but not essential) can become obligate mutualism if one partner evolves dependence on the other. What unites symbioses is long-term association: the partners influence each other's behaviour, physiology, and survival, creating links that can be stabilising in one context and risky in another.

B

Above ground, mutualism is often easiest to see in pollination, where plants exchange resources for transport services. Flowering plants advertise with colour, scent, and shape, offering nectar or pollen as food while insects and other animals carry pollen between blooms. Some partnerships are highly specialised: certain orchids, for example, rely on a narrow set of pollinators, and many bee species show strong preferences for particular flower types. This specialisation can increase efficiency—pollen is delivered to the right species rather than wasted—yet it also creates vulnerability if a pollinator declines. In more generalised systems, multiple insects visit the same plant, and the “service” of pollen transfer is spread across a network of visitors. Whether specialised or broad, the biological exchange is clear: energy-rich food is traded for the movement of genetic material, linking reproduction to animal behaviour.

C

Below ground, plants enter a different kind of mutualism through mycorrhizal fungi, which form extensive networks around and within roots. These fungi can dramatically increase the surface area available for absorption, accessing water and soil minerals that roots alone cannot easily reach. A key benefit is improved uptake of nutrients such as phosphorus, which is often limiting in terrestrial ecosystems. In return, plants export carbon fixed by photosynthesis, supplying carbohydrates to fungal partners. Because mycorrhizal networks can connect multiple plants, they may also influence competition and cooperation within plant communities, redistributing resources in ways that depend



on soil conditions and species composition. The partnership is usually facultative in the sense that many plants can survive without a specific fungus, but in nutrient-poor soils the association can become close to essential, shaping where plants can establish and how well they grow.

D

Commensalism occupies a middle position on the symbiotic spectrum, where one species benefits and the other is largely unaffected. Barnacles attached to whales illustrate this pattern: the barnacles gain “hitchhiking” transport to plankton-rich waters without investing energy in movement, while the whale typically experiences little cost. Similar relationships are seen when remoras attach to sharks, using a suction disc to travel efficiently and feed on scraps. Although the host may not gain a direct benefit, commensal hitchhiking can still matter ecologically because it allows the commensal to expand its habitat and reach new feeding grounds. Over evolutionary time, such low-cost associations can set the stage for relationships to shift along the continuum, becoming more mutualistic if the host begins to gain a service, or more parasitic if costs increase.

E

Parasitism highlights the more exploitative side of symbiosis and is shaped by host-parasite dynamics. Parasites draw resources from hosts, often reducing health or reproductive success, but successful parasites do not necessarily maximise immediate damage. Instead, natural selection can favour intermediate virulence: harming the host enough to extract resources, but not so much that the host dies before the parasite can spread. This produces an evolutionary arms race in which hosts evolve defences—immune responses, avoidance behaviours, or physical barriers—while parasites evolve countermeasures such as immune evasion or rapid reproduction. The outcome is often a chronic infection that persists over time, sometimes with symptoms that fluctuate depending on host condition and environmental stressors. Parasitism therefore demonstrates that “harm” in symbiosis can be strategically moderated, not simply maximised.

F

Some of the most consequential symbioses occurred deep in evolutionary history and are explained by the endosymbiotic theory, strongly associated with Lynn Margulis. According to this account, mitochondria were once independent bacteria that entered larger host cells and, over time, became integrated into cellular life. Rather than remaining temporary residents, these bacteria formed an internal partnership: genes were transferred to the host genome, metabolic roles became coordinated, and the former bacteria lost the capacity to live independently. This merger transformed energy production. By hosting



efficient internal powerhouses, early eukaryotic cells gained the energetic capacity to support larger genomes and more complex structures. The theory therefore treats a symbiosis not as a minor ecological interaction, but as a mechanism that reshaped the possibilities of life on Earth.

G

Symbioses can also be fragile, and few examples are as visible as coral reefs under thermal stress. Many reef-building corals depend on symbiotic algae called zooxanthellae, which live within coral tissues and provide much of the coral's energy through photosynthesis. In return, the algae gain shelter and access to nutrients. When ocean temperatures rise beyond a tolerable range, the partnership can break down: corals expel the zooxanthellae, leading to "bleaching" as the coral's pale skeleton shows through. Without their algal partners, corals may starve even if the animals themselves are not immediately killed by heat. Bleaching illustrates the cost of dependence in obligate mutualism: a relationship that is highly productive under stable conditions can become a liability when the environment changes rapidly.

Questions 1–6

Choose the correct heading for Paragraphs A–F from the list of headings below.

List of Headings

- i A theory linking symbiosis to the rise of complex cells
- ii Underground networks trading carbon for scarce minerals
- iii The vulnerability associated with highly specialised pollination
- iv A partnership spectrum that can shift with conditions
- v Why parasites may evolve to avoid killing hosts quickly
- vi How hitchhiking relationships may develop into mutualism
- vii Trading food for reproductive transport in pollination systems
- viii How zooxanthellae support reef ecosystems
- ix Hitchhiking relationships that expand a species' range

1 Paragraph A

2 Paragraph B

3 Paragraph C

4 Paragraph D

5 Paragraph E

6 Paragraph F



Questions 7–10

Complete the notes below. Choose **ONE WORD ONLY** from the text for each answer.

Biological Partnerships

- Plants supply their fungal partners with **7**; these substances are produced using carbon fixed through photosynthesis.
- By attaching to whales, barnacles obtain **8** to waters where plankton is abundant.
- According to the endosymbiotic theory, mitochondria developed from formerly independent **9**
- Much of the energy used by reef-building corals is provided by symbiotic algae called **10**

Questions 11–13

Choose **TRUE** if the statement agrees with the information given in the text, choose **FALSE** if the statement contradicts the information, or choose **NOT GIVEN** if there is no information on this.

11 The passage presents symbiosis as a category that can include a relationship harmful to one of the organisms involved.

12 The passage suggests that parasites generally benefit by killing their hosts as quickly as possible.

13 The passage identifies a particular ocean depth at which coral bleaching starts.

Answer Key

- iv
- vii
- ii
- ix
- v
- i
- carbohydrates



- 8. transport
- 9. bacteria
- 10. zooxanthellae
- 11. TRUE
- 12. FALSE
- 13. NOT GIVEN