



PART 3

Read the text below and answer questions 27–40.

REDEFINING THE INDIVIDUAL: THE HOLOGENOME THEORY

A

Evolutionary biology has traditionally answered the question “What changes through time?” with a reassuringly solid object: the individual organism, carrying a genome, competing and reproducing. Yet the apparently simple noun “individual” hides a philosophical problem. A mammal is not merely mammalian cells; it is also a crowded habitat of microbes that influence digestion, immunity, development, and even behaviour. If survival and reproduction depend on these microbial partners, then the standard Darwinian picture—selection acting on a self-contained organism—begins to look like a form of reductionism, useful for some purposes but incomplete. The deeper challenge is conceptual: where do we draw the boundary of the thing that selection is shaping, and what counts as a heritable trait when the trait depends on partners that are not strictly “part of” the host body?

B

The holobiont concept proposes a radical answer. A holobiont is the host plus its associated microorganisms, treated as an integrated biological unit in ecology and evolution. Extending this, the hologenome refers to the collective genetic repertoire of the holobiont: the host genome combined with the genomes of its microbes. This is not merely a poetic metaphor. Microbes supply enzymes the host lacks, train immune systems, occupy niches that exclude pathogens, and generate molecules that modulate host physiology. If these functions are stable enough to influence fitness, then selection may act on the performance of the consortium rather than on the host alone. The theory does not deny that genes matter; it questions whether the host’s genes are the only relevant genetic substrate. In this view, an “organism” is partly a managed ecosystem, and adaptation can occur through shifts in membership and microbial gene content as well as through mutation in host DNA.

C

A key reason the idea feels disruptive is that it rubs against the classic Weismann barrier: the nineteenth-century principle that inheritance passes through reproductive cells, insulated from most changes occurring in the body. This barrier underwrites a strict Darwinian intuition: acquired changes to tissues during life—diet-driven shifts, injuries, learned habits—cannot directly rewrite what offspring inherit. Microbes complicate this picture because they are not confined by the same rules. Many are acquired from the



environment, from food, from conspecifics, or from the surrounding habitat, and some are transmitted within families without being encoded in the host genome. Even when host genes remain unchanged, the functional traits of the holobiont can shift if its microbial partners change. The germline barrier still applies to host DNA, but the holobiont's "inheritance" can include ecological acquisition, making the boundary between inheritance and environment less rigid than the traditional model assumes.

D

This is where the provocative phrase "Lamarckian evolution" enters the discussion. Lamarck's name is often invoked to mean the inheritance of acquired characteristics, a view long contrasted with Darwinian selection on random variation. Hologenome proponents typically do not claim that a host deliberately rewrites its genes; instead, they argue that microbial change allows a Lamarckian-like pathway at the level of phenotype. During a host's lifetime, the microbial community can adjust rapidly to a new diet, toxin exposure, or habitat, producing new metabolic capacities or altered immune signalling without waiting for slow genetic change in the host. The host, in effect, can "acquire" functional traits through microbial restructuring. Critics respond that this is better described as phenotypic plasticity than as true Lamarckism, because the host genome is not being instructed by need. Supporters counter that the speed and functional impact of microbial shifts make the process evolutionarily consequential, even if the mechanism is indirect.

E

The case becomes stronger when microbial genetics themselves are considered. Bacteria can engage in horizontal gene transfer, swapping genes across lineages through mechanisms such as plasmids and viral vectors. Inside a gut, where microbes are dense and metabolically active, this can generate a genetic web rather than a simple family tree. New enzymatic functions can spread through a community on ecological timescales, potentially altering what the holobiont can digest, detoxify, or resist. From a strict host-centric perspective, such changes are "external" and therefore irrelevant to heredity. From a hologenome perspective, they are part of the adaptive repertoire that the host routinely recruits. The unit that persists is not a fixed set of microbial species but a functional capacity maintained by community dynamics, gene flow, and selective filtering within the host environment.

F

A concrete illustration comes from human digestion in populations where seaweed has been a long-standing dietary component. Certain seaweeds contain complex carbohydrates that are difficult for many human digestive systems to break down.



Researchers have identified gut bacteria in some individuals that carry enzymes capable of degrading these marine polysaccharides, and evidence suggests that these genes entered gut microbes via horizontal gene transfer from marine bacteria associated with seaweeds. The key evolutionary point is not that humans acquired new digestive genes in their own genomes, but that a dietary practice created repeated exposure to microbial genes, enabling a microbial solution to become integrated into digestion. The host benefits immediately when the microbial function is present; the trait can spread culturally through diet and ecologically through microbial transmission, even before any host-genetic adaptation occurs. The example shows how a holobiont can display rapid, population-level change through microbial genetics and ecology, creating a pathway that looks “Lamarckian” in speed and directionality while still operating through selection and retention of beneficial configurations.

G

If the holobiont is taken seriously, the implications reach beyond evolutionary theory into policy and practice. In medicine, it reframes some diseases as breakdowns in community function rather than defects in a single genome, suggesting interventions that manage networks—dietary shifts, targeted microbial therapies, or ecological restoration of microbial diversity. In conservation, it challenges the assumption that saving a species means saving a genome: what must be protected may be a set of relationships that sustain development, immunity, or stress tolerance. At the same time, the hologenome theory remains controversial because it complicates attribution. If an organism’s success depends on many partners, selection may act at multiple levels, and causal explanations become harder, not easier. Still, the theory’s value may lie precisely in that discomfort: it forces biology to confront whether the “individual” is a natural unit or a convenient simplification, and whether adaptation sometimes proceeds through managed ecosystems rather than isolated genomes.

Questions 27–32

Choose **YES** if the statement agrees with the claims of the writer, choose **NO** if the statement contradicts the claims of the writer, or choose **NOT GIVEN** if it is impossible to say what the writer thinks about this.

27 The writer suggests that the biological definition of an “individual” may need revision.

28 The writer claims that the holobiont concept makes natural selection irrelevant.

29 The writer argues that microbes are inherited only through parents in the same way as host DNA.



30 The writer implies that the Weismann barrier prevents any rapid change in host-related traits.

31 The writer suggests that gene sharing among bacteria can create a “web” of genetic change within a gut community.

32 The writer states that the hologenome theory is universally accepted among evolutionary biologists.

Questions 33–36

Look at the following summary and the list of words below. Choose the correct letter, **A–H**.

Mechanisms of Adaptation

In the traditional model, the cells responsible for transmitting inherited change are

33 The boundary separating changes in the body from biological inheritance is known as the **34** Microbial restructuring can produce rapid functional changes during a host’s lifetime, although critics describe this as **35** rather than true Lamarckism. Within microbial communities, new functions can spread between bacteria through **36**

A genetic exchange

B reproductive cells

C acclimatisation

D reductionism

E germline barrier

F phenotypic plasticity

G vertical inheritance

H selective pressures

Questions 37–40

Select the correct answer.

37 What is the significance of the “Weismann barrier” in the writer’s argument?

A It shows that microbial changes cannot contribute to evolution unless they alter the host’s own DNA.

B It represents the traditional separation of bodily change from inheritance, which microbial acquisition and transmission make less rigid at the holobiont level.

C It establishes that the host genome is protected from every environmental influence, although microbes may affect short-term metabolism.



D It explains why environmentally acquired microbes must enter the host's reproductive cells before natural selection can act on them.

38 What particular advantage of microbial change is emphasised in the passage?

A It can generate useful functional changes on ecological timescales before slow host-genetic adaptation occurs.

B It makes acquired functions more reliably inherited because microbial communities are more stable than host genomes.

C It allows hosts to retain an unchanged set of microbial partners while altering the metabolic roles those partners perform.

D It enables adaptation to occur without selection because microbial communities respond directly to the host's immediate needs.

39 Why does the writer indicate that the holobiont concept remains controversial?

A It is difficult to establish whether microbial functions remain sufficiently stable to influence the host's fitness.

B Evidence for microbial gene transfer comes mainly from dietary examples and cannot be applied to medicine or conservation.

C It complicates the identification of the unit of selection and makes causal attribution across biological partners less straightforward.

D It treats host genes as irrelevant and therefore cannot explain the stable inheritance of biological traits.

40 What overall implication does the writer draw for biology?

A The holobiont should replace the individual host as the only valid unit of selection in every biological context.

B Microbes acquired during life should be excluded from evolutionary accounts because they belong to ecology rather than heredity.

C The hologenome theory is mainly useful in medicine and conservation but has little relevance to general evolutionary theory.

D Biology may need to treat organisms as networked systems in which health and adaptation emerge from relationships as well as genes.

Answer Key

27. YES

28. NO

29. NO



30. NO

31. YES

32. NO

33. B

34. E

35. F

36. A

37. B

38. A

39. C

40. D