



PART 1

Read the text below and answer questions 1–13.

LEARNING FROM NATURE: THE PRINCIPLES OF BIOMIMICRY

Biomimicry is the disciplined practice of learning from living systems and translating their strategies into human design. It is often confused with biomorphism, which merely borrows nature’s visual language—leaf-like curves, honeycomb patterns, animal silhouettes—without necessarily reproducing nature’s performance logic. The distinction matters because living organisms are not “beautiful solutions” in the abstract; they are conditional solutions shaped by constraints: scarcity of energy, limited materials, fluctuating temperatures, predators, pathogens, and the relentless pressure to do more with less. Biomimicry therefore aims to understand how organisms achieve functions—locomotion, thermoregulation, adhesion, filtration, structural strength—under real-world trade-offs, and then convert those principles into designs that can be tested, manufactured, and maintained.

A common starting point is to rewrite a design brief in functional terms. Instead of asking, “How do we make a better bottle?”, practitioners ask, “How does nature store liquids with minimal waste and maximal safety?” The shift sounds rhetorical, yet it is methodological: it widens the search space from familiar industrial precedents to biological strategies that have been refined across evolutionary time. This functional framing also discourages “solution shopping” (choosing a charismatic organism first and forcing it onto the problem) and encourages teams to specify measurable objectives—durability, energy use, repairability, toxicity reduction—before they decide what “nature-inspired” should mean in practice.

Within this framework, practitioners often describe three levels of biomimicry. At the level of form, designers borrow morphology—shapes, textures, or surface features that confer performance. A frequently cited example is shark skin: microscopic riblets on the surface can reduce drag and inhibit biofouling, inspiring hydrophobic or low-friction coatings for ships and medical surfaces. At the level of process, the emphasis shifts from what something looks like to how it is made. Many organisms fabricate materials at ambient temperatures and pressures, using water-based chemistry and incremental layering; the abalone shell is emblematic, building toughness through hierarchical structure rather than high-temperature smelting. At the system level, biomimicry focuses on relationships and circular flows. Forest ecosystems, for instance, operate through closed-loop nutrient cycles in which “waste” from one process becomes input for another, a logic increasingly



used to design circular material systems and industrial symbiosis rather than a single product.

Successful biomimicry case studies typically rely on a sequence of observation followed by abstraction. Observation involves careful field study or microscopy to identify how a biological strategy actually works; abstraction is the intellectual step of extracting a general principle that can be expressed in engineering terms. The classic example is Velcro. In 1948, the Swiss engineer George de Mestral examined burdock burrs that clung stubbornly to clothing and animal fur. Under magnification, he found tiny hooks that latched onto loops in fibres. The biological mechanism was then abstracted into a manufacturable fastening concept: hook-and-loop strips whose performance could be measured, iteratively refined, and scaled. The important point is that the breakthrough was not the burr's appearance, but the transferable mechanism, and the painstaking work of translating it into tolerances, materials, and production methods.

Architecture and urban design have also drawn on biomimetic reasoning, though the translation is more contested because buildings are embedded in complex social and climatic contexts. Termite mounds are often cited for passive ventilation: certain species regulate internal temperature and gas exchange through porous walls and pressure-driven airflow pathways. Designers have used these ideas to pursue low-energy cooling strategies, and the Eastgate Centre in Harare is widely discussed as a project influenced by termite-mound principles, combining thermal mass, ventilation, and controlled air movement to reduce reliance on mechanical cooling. Yet such applications also demonstrate a key lesson of biomimicry: performance depends on context—local climate, occupancy patterns, maintenance regimes, and operational control—so an inspiring analogy does not guarantee identical outcomes.

Indeed, biomimicry can fail when designers take nature out of context. Copying a surface pattern without understanding operating conditions can create products that perform impressively in a demonstration yet degrade under real loads, contamination, or wear. Other failures are ethical rather than mechanical. “Greenwashing” occurs when a product is described as sustainable merely because it was inspired by nature, even if it uses toxic inputs, relies on carbon-intensive manufacturing, or encourages disposable consumption. Biomimicry is a strategy for innovation under constraint; it does not automatically deliver material efficiency, nor does it necessarily produce structures that use minimal material. Poor translation, inappropriate materials, or misaligned incentives can lead to designs that are heavier, more complex, or less repairable than conventional alternatives.

To avoid superficial imitation, many teams use evaluative frameworks such as Life's Principles, which emphasise resource efficiency, adaptability, diversity, and benign



chemistry. In practice, these principles are operationalised through an iterative process: set targets (for energy, durability, emissions, repairability), prototype, test in realistic conditions, and revise. This is also where biomimicry differs from bio-utilization—the direct use of biological materials (such as plant fibres or bacterial cellulose) without necessarily emulating a biological strategy. A design can use “natural” materials and still be environmentally harmful, just as a design can emulate a biological process and still be unsustainable if it is manufactured or deployed irresponsibly.

Finally, biomimicry raises questions about ownership and fairness. Biological knowledge is not always “free”: it may be embedded in indigenous practices, local ecological expertise, or biodiverse regions whose communities have stewarded ecosystems for generations. When firms patent designs derived from biological strategies, concerns arise if intellectual property restricts access to solutions that serve public needs—such as low-cost water filtration or passive cooling in heat-stressed regions. Ethical biomimicry therefore increasingly includes benefit-sharing, appropriate credit, and governance norms that treat nature-inspired innovation as a social practice, not just a technical one. When done well, biomimicry moves from admiration to accountable application: it translates function into design, tests abstraction against reality, and measures success by tangible improvements rather than by the romance of inspiration.

Questions 1–4

Select the correct answer.

1 What does the passage suggest is a common starting point in biomimicry?

- A** selecting an organism whose appearance can be copied accurately
- B** restating the design problem in terms of the function it must perform
- C** testing a natural material directly to see whether it can replace a synthetic one
- D** identifying the final product requirements before considering biological examples

2 Which level of biomimicry is concerned mainly with relationships and circular flows?

- A** form
- B** process
- C** system
- D** surface

3 In the passage, the term “abstraction” refers to

- A** reducing a biological structure to its simplest visual pattern
- B** extracting a principle from observation so it can be translated into a testable design



- C** using computer simulation to replace field observation
- D** adapting an organism's chemistry to industrial manufacturing conditions

4 Which statement best reflects the passage's view of biomimicry and sustainability?

- A** Nature-inspired designs are usually sustainable because they imitate living systems.
- B** Sustainability should be judged by measurable improvements rather than inspiration alone.
- C** Biomimicry is sustainable only when it produces materials at low temperatures.
- D** Biomimicry tends to be most effective when it is applied in architecture rather than products.

Questions 5–9

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.

5 The passage suggests biomimicry involves translating how living organisms meet functional challenges into human design, rather than replicating nature's appearance.

6 The passage states that abstraction is usually more difficult than observation in biomimicry projects.

7 The passage suggests that a nature-inspired design may succeed in a demonstration yet perform poorly in everyday conditions if its operating context is misunderstood.

8 The passage claims that biomimicry necessarily results in structures that use minimal material.

9 The passage suggests concerns may arise when intellectual property based on biological strategies limits access to solutions intended to serve wider public needs.

Questions 10–13

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

The Biomimicry Design Process

A design brief is commonly rewritten in **10** terms before biological strategies are explored. Practitioners may work at the level of form, process, or **11** Successful applications often involve careful observation followed by **12**, so that principles can be tested and manufactured. To guard against superficial claims, some teams use evaluation frameworks such as Life's **13**



Answer Key

1. B
2. C
3. B
4. B
5. TRUE
6. NOT GIVEN
7. TRUE
8. FALSE
9. TRUE
10. functional
11. system
12. abstraction
13. Principles