

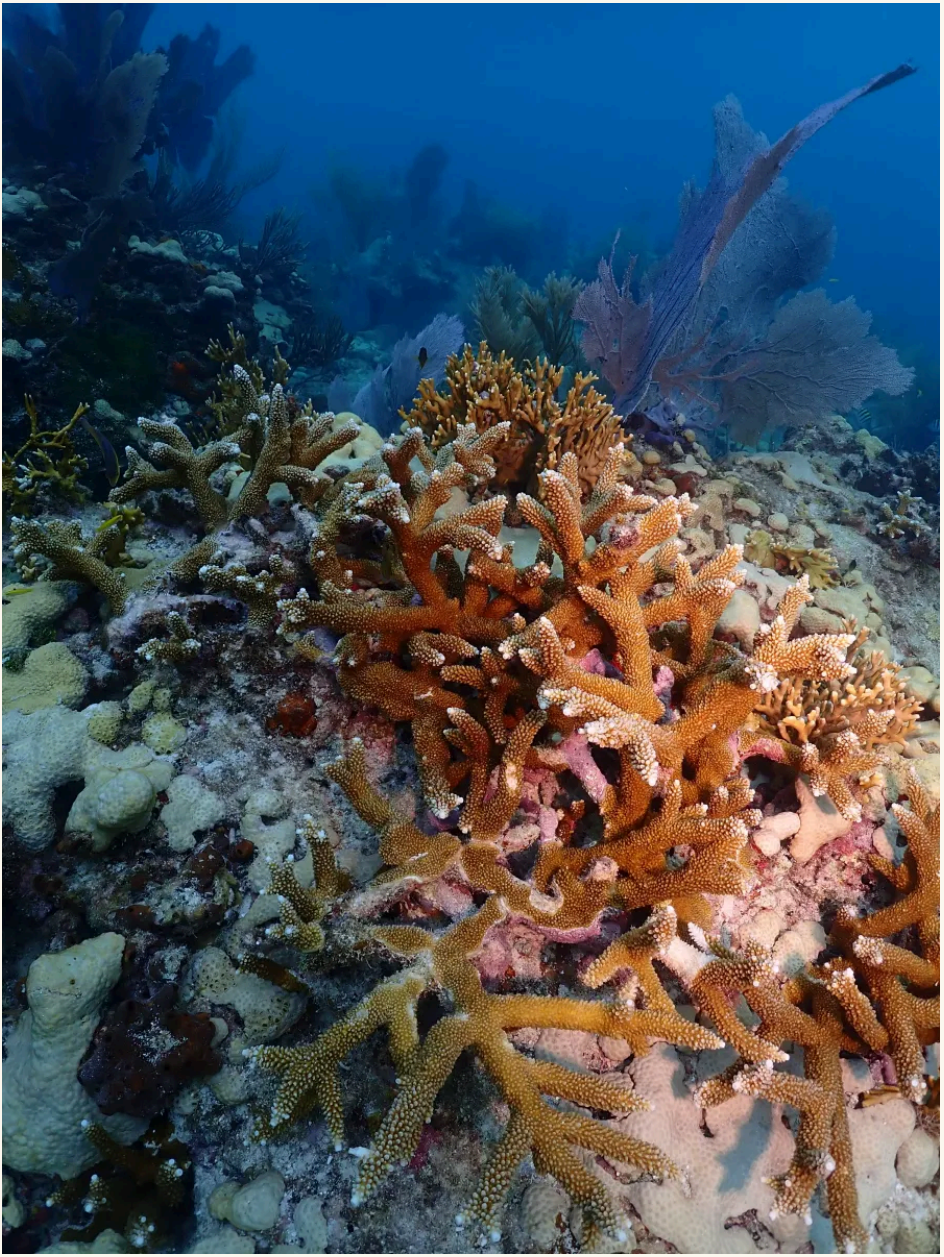
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Biorock: Growing a Reef Its Mineral Skeleton

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Biorock: Growing a Reef Its Mineral Skeleton

Some damaged coral reefs can recover naturally when conditions improve. Recovery may be slow, or blocked by continuing stress. Biorock is one technique used to assist reef restoration: it grows a mineral skeleton using a weak electric current. **UPSC 2022 asked what Biorock is used for.**



Staghorn coral fragments transplanted as part of a reef restoration effort. Photo by Symbiosis, CC BY 2.0, via Wikimedia Commons.

At a Glance

Four facts to hold on to.

01
Use

Restoring damaged coral reefs.

02
Method

Weak current grows limestone on a steel frame.

03
Inventor

Wolf Hilbertz, 1976.

04
India

Gulf of Kachchh, 2020.

Cathode The negative electrode where minerals deposit.
Accretion Slow build-up of a mineral layer.
Coral fragment A small piece of living coral that is transplanted.
Biorock The name for coral-growing mineral accretion.

What Biorock Is For

Must Know

The core idea

- Biorock uses a weak electric current in seawater.

- A steel frame acts as the **cathode**.
- Dissolved calcium and carbonate form a **limestone-like layer** on the frame.
- Coral fragments are attached to this hard base.
- The current must stay safe and well controlled.
- The frame gives structure. It does not create a full reef ecosystem alone.
- Source: Biorock (Wikipedia).

> **Quick check 1.** Biorock technology is talked about in the context of restoring damaged coral reefs. *(True or False?)* See answer ↓

How It Grows a Reef

Good to Know

From frame to reef

- Restorers attach living coral fragments from suitable sources.
- Fish and other animals may later use the growing structure.
- Power supply, corrosion, storms, heat stress and upkeep all affect results.

Do not generalise one site

- Growth effects vary by species and electrical conditions.
- A 2022 field review reports about three to five times faster growth for most measured organisms. Some cases were higher.
- Source: 2022 field review (Frontiers in Marine Science).
- Restoration cannot replace emission cuts, clean water, fishing controls and protection of surviving reefs.

Quick check 2. A low-voltage electric current makes calcium carbonate crystallise onto a steel frame. *(True or False?)* See answer ↓

Exam Edge

Previous Year Questions

UPSC 2022 asked in which situation Biorock technology is talked about.

Asked before

PYQ 1 · UPSC CSP 2022, Q49

"Biorock technology" is talked about in which one of the following situations?

(a) Restoration of damaged coral reefs
(b) Development of building materials using plant residues
(c) Identification of areas for exploration/extraction of shale gas
(d) Providing salt licks for wild animals in forests/protected areas

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Quick check 3. UPSC 2022 confirmed Biorock is used to provide salt licks for wild animals. *(True or False?)* See answer ↓

Real Origins and a Real Indian Site

Great to Know

Who built it

- Wolf Hilbertz, an architect, developed seawater mineral accretion in 1976.
- He first aimed to grow building material in the sea.
- Marine biologist Thomas Goreau adapted it for reefs from 1987.
- Together they promoted it as Biorock.
- Source: Biorock (Wikipedia).

India: Gulf of Kachchh

- The Zoological Survey of India worked with the Gujarat Forest Department.
- A Biorock structure went in about one nautical mile off Mithapur on 19 January 2020.
- Solar panels supplied the power.
- Such projects are demonstrations. They do not prove recovery of a whole reef system.
- Source: Drishti IAS note.

What UPSC wants

- UPSC tests the core use: restoring damaged coral reefs.
- Technical detail should not hide that simple answer.

> **Think it through: why might a ready-made mineral skeleton help transplanted coral grow?**
>
> On a natural reef a coral builds its own limestone skeleton, which costs energy. A Biorock frame already has a mineral base. The coral can spend that saved energy on growth and repair. This is the usual explanation, and it varies by species and site.

> **Quick check 4.** Wolf Hilbertz developed the underlying mineral-accretion process in 1976, first for building material in the sea. *(True or False?)* See answer ↓

> **Quick check 5.** A Biorock structure was installed off Mithapur in the Gulf of Kachchh in January 2020. *(True or False?)* See answer ↓

Quick check 6. Biorock growth rates are the same across all coral species and electrical conditions. *(True or False?)* See answer ↓

October 2026 Update

Current Affairs

Symbiont Transfer: Bleached Corals Revived in the Lab (2026)

- **The problem:** Heat stress makes corals lose the tiny algae that live in their tissue. These algae feed the coral and give it colour. Without them the coral turns white. This is bleaching.
- **Stanford study:** Daniel Collins and colleagues published it in *Science Advances* on 14 October 2026. They used *Pocillopora damicornis* coral. Bleached fragments were placed touching healthy, genetically identical ones. The tissues fused. Algae moved into the bleached tissue.
- **The result:** All five touching bleached fragments recovered. Stanford says it took seven weeks. The paper says within eight weeks. The five bleached controls kept apart did not recover. Stanford reports that they died. This was a lab test on small fragments, not a reef trial.
- **Australian study:** Scientists at the Australian Institute of Marine Science published “Stronger Together” in *Environmental Microbiology Reports* (October 2026). They used heat-evolved algae called SS8. Fusion began after three days in *Galaxea fascicularis* and nine days in *Psammocora columna*.
- **The catch:** In *Galaxea fascicularis*, SS8 appeared at low levels (under 3.5%) in 15 of 19 fused recipients after about 50 days. It also appeared in 13 of 18 unfused controls sharing the same water. So direct tissue transfer is hard to separate from uptake through water.

- **Global and Indian context:** NOAA's June update says the fourth global bleaching event likely ended in 2025. Heat stress hit 84.4% of reef area. Mass bleaching was seen in at least 83 countries and territories. These figures measure heat stress, not coral deaths. India's December 2024 assessment (PIB) found widespread bleaching in Lakshadweep, patchy bleaching in the Gulf of Mannar and small-scale bleaching in South Andaman.
- **So what:** [Mains Fodder] Biorock gives corals a surface to grow on. Symbiont transfer tries to fix the heat damage itself. Both are lab or pilot ideas. Neither replaces cutting emissions.
- Sources: Stanford News, Environmental Microbiology Reports paper, NOAA Coral Reef Watch, PIB.

Quick Q&A

Biorock is used for?

Restoring coral reefs.

Who developed the process?

Wolf Hilbertz.

Which electrode gets the mineral layer?

The cathode.

Indian site?

Gulf of Kachchh.

Does it replace emission cuts?

No.

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Practice MCQs

1. "Biorock technology" is talked about in which one of the following situations?

A. Development of building materials using plant residues

B. Providing salt licks for wild animals in forests/protected areas

C. Identification of areas for exploration/extraction of shale gas

D. Restoration of damaged coral reefs

See answer ↓

2. How does Biorock technology actually help coral reefs grow faster?

A. It injects synthetic fertiliser directly into coral tissue

B. It genetically modifies coral polyps to grow faster

C. It removes all fish from the reef area to reduce competition

D. A low-voltage electric current makes minerals crystallise onto a submerged steel frame, forming a base corals grow on

See answer ↓

3. Where in India has Biorock technology actually been used to restore coral reefs?

A. Chilika Lake, Odisha

B. Gulf of Kachchh, Gujarat

C. Sundarbans, West Bengal

D. Vembanad Lake, Kerala

See answer ↓

Answer Key

1. **D.** Biorock technology is used to restore damaged coral reefs by growing a mineral base for coral transplants. ↑ Q1
2. **D.** A low-voltage electric current passed through a submerged steel framework causes calcium carbonate and magnesium hydroxide to crystallise onto it, forming a limestone-like base that helps transplanted corals grow faster. ↑ Q2
3. **B.** The Zoological Survey of India, with support from the Gujarat Forest Department, has used Biorock technology to restore coral reefs in the Gulf of Kachchh. ↑ Q3

Quick-check answers

1. **True.** ↑ 1
2. **True.** ↑ 2
3. **False.** ↑ 3
4. **True.** ↑ 4
5. **True.** ↑ 5
6. **False.** ↑ 6

Previous year answers

1. **(a) Restoration of damaged coral reefs**

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