# Using Novel Natural, Eco-Friendly Materials to 3D Print & Mold Coral Skeleton for Coral Reef Restoration

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Coral reefs support over 25% of marine life and play a critical role in producing 50% of the oxygen we breathe. Scientists predict that by 2030, 90% of coral reefs will be endangered due to coral bleaching driven by global warming, pollution and ocean acidification. Current restoration methods through synthetic coral skeletons often rely on using base materials that could potentially harm the environment, such as plastic and concrete as a printing & molding ink, which also lack sustainability. This study presents a sustainable, eco-friendly and cost-effective alternative to restore corals by using five novel natural materials; shrimp shells, egg shells, sodium alginate, agar and calcium carbonate. These were ground into a fine powder and mixed with soybean oil resin to create pastes suitable for 3D printing. Coral plugs were then molded using all materials, and live coral micro fragments were applied on them. The plugs were placed in an aquarium tank, simulating the marine environment of the Red Sea. Finally, monthly 3D scans of the coral fragments were performed to obtain growth measurements in area and volume, and each material was characterized through SEM imaging and mechanical testing. Although it was found that sodium alginate plugs exhibited swelling and degradation after the first week of deployment, promising growth was observed across all other materials, highlighting the potential of using these materials to restore coral reefs. These findings are promising for future projects aimed at sustainable coral restoration, aligning with broader goals of environmental sustainability and conservation.

**Awards Won:**