How Can We Restore Coral Reefs?

Bionic Bulldogs 22198

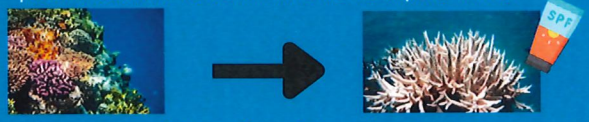
Identify: Why Are Coral Reefs Dying?

Ocean Acidification:

Climate change increases CO_2 levels, CO_2 mixes with ocean water to form carbonic acid ($CO_2 + H_2O \rightarrow H^+ + HCO_3^-$). This lowers the pH, weakening coral skeletons and making it difficult for coral to thrive.

Coral Bleaching:

Rising temperatures and pollution lower ocean pH and cause coral to expel algae, their main food source. This turns coral white and puts it under stress, leading to potential death and the loss of marine life that depends on reefs.



Ideas Considered:

- Plastic Awareness: Create 3D printed reusable lunch containers from recycled plastic for our school.
- Safe Sunscreen: Develop a coral-safe sunscreen that uses nonharmful chemicals inspired by Science World's article "Coral Killer" and kids from Waipahu High School.
- Fundraiser: Organize a dress-down day to raise funds for an ocean support initiative.

Chosen Idea: Restoring Coral Reefs

Our robot will pick up coral pieces, then divers will replant the coral using safe cement made from salt and water. Next, our robot will plant seagrass which absorbs CO_2 in low pH conditions. Finally, underwater speakers attached to coral mazes will mimic the sounds of thriving coral and fish to encourage coral growth.

Why?: Coral reefs support 25% of ocean life, making them vital to the ecosystem. Research from a documentary, "Chasing Coral" shows that the sound of healthy coral increases the chances of regrowth, even in bleached areas, and helps new coral thrive. This solution promotes a healthier ocean ecosystem and aligns with sustainability goals.

Understanding pH levels via Hydroponics System:

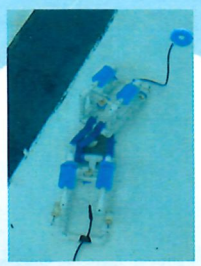
- PURPOSE: To study the effects of pH on ecosystems and draw parallels with coral reef health.

- IMPLEMENTATION: Grew lettuce using water, artificial light, and nutrients as well as monitored pH (potential hydrogen = acidity) and TDS (Total Dissolved Solids) levels daily -- revealing how these factors impact plant and ecosystem health.

- COMMUNITY IMPACT: Originally shared lettuce with school community, but expanded our fresh produce supply to local organization, Face to Face, whose primary goal is to improve food insecurity in Greater Philadelphia.

- ENVIRONMENTAL IMPACT: Raised awareness about endangered coral reefs by informing community members about the importance of coral ecosystems.

- OUTCOME: Combined experimental learning with community outreach to highlight the connection between sustainable practices and ocean conservation.


Experts/Collaborations:

- Mr. Alferman and Mr. Fonash assisted with motor and electronic assembly.
- Professor ElBardissi from Sea Perch donated supplies and tools.
- Motivated 8th graders to build prototypes in the engineering design process.
- Presented to the Ladies of Mt. Carmel at a potluck dinner to practice in front of an authentic audience.
- Created a cement mixture designed by Experts in Bali.
- Visited a local business, Raymers Candy, who made chocolate coral reefs to help raise community awareness on how to restore coral reefs.
- Engineers Dr. Elliott and Mr. Hayden shared expertise on CAD and 3D printing.
- Mr. Alcaro, retired Naval Officer on fast attack submarines, taught about buoyancy and underwater robots.

Coral Restoration Robot Design Iterations:

- INITIAL DESIGN: A Roomba shaped body with ability to measure ocean's pH and a speaker that plays healthy coral reef sounds to attract coral larvae and promote coral regrowth.

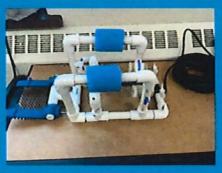
- SECONDARY DESIGN: Fellow 8th graders built prototypes using Robotics Workshop Kits. When Temple professors caught wind of this work, they provided PVC parts and tools to elevate the design and informed the team about the Sea Perch competition.

- IMPROVED DESIGN: Assembled a Sea Perch robot that picks up coral pieces and plants seagrass by dropping bags filled with seeds to the sea floor.



How We Built the Robot:

- Followed instructions provided by Sea Perch to build the robots out of PVC pipe.
- Learned how to strip wires, solder wires to motors, and waterproof motors using wax. Noted that melting point can vary when using different waxes.
- Zip tied motors to PVC pipe and added pool noodles for buoyancy.
- Tested different 3D printed fork designs to understand which would operate underwater best. Added nets to make picking up coral easier!
- Tested various designs in a pool

Next Steps:

- Go to Sea Perch Competition run by retired Navy that will better inform the team on mechanics of underwater robotics while testing the robot's functionality.

- 3D print Terracotta mazes under the supervision of Fab Lab's lead innovator Mr. Hayden. The mazes will act as structures for the coral reefs to grow on.

- Add sound speakers to Terracotta mazes that will play thriving coral reef sounds to encourage reef restoration and strong ecosystem health.