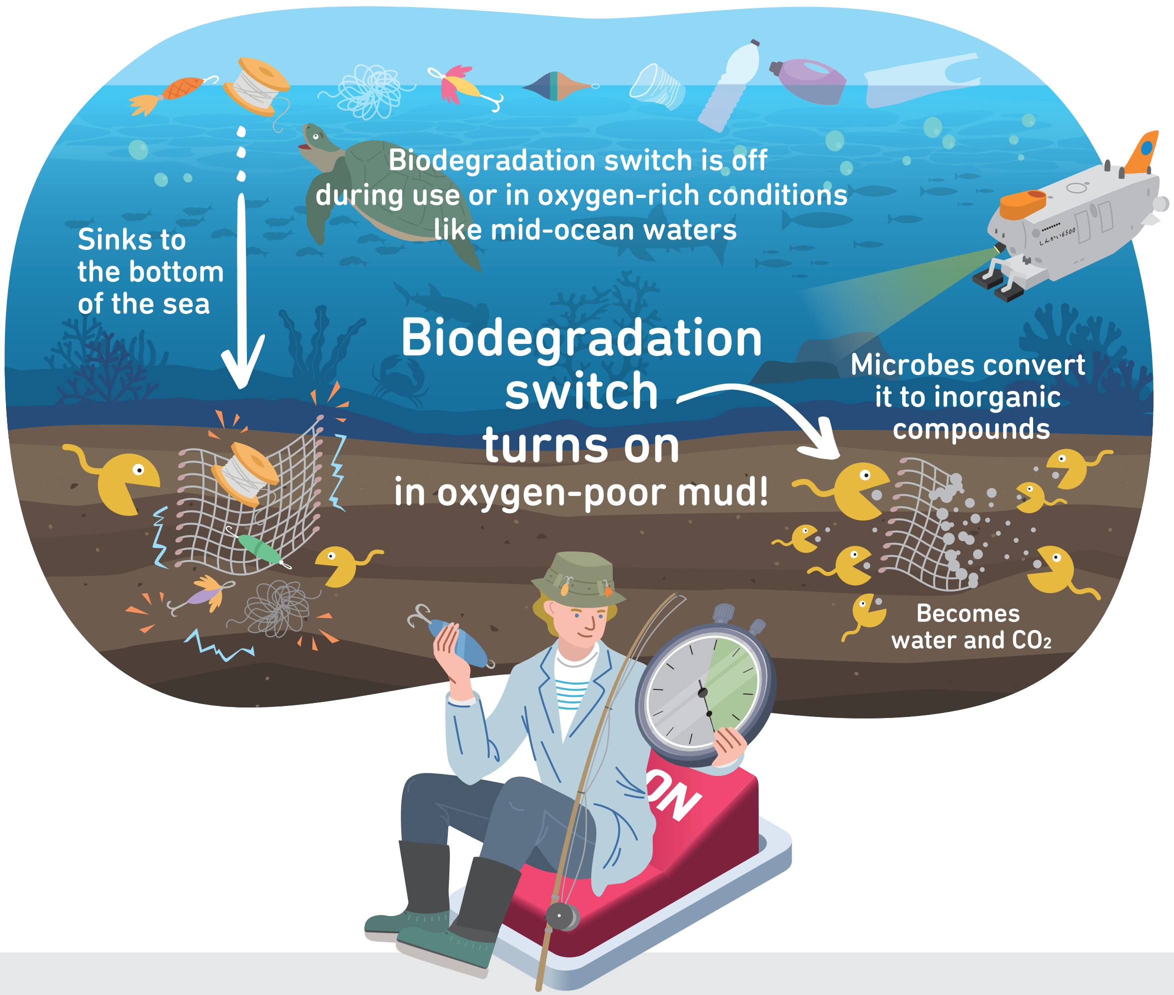
15 PROJECT

Durable Fishing Tackle and Gear That Biodegrade on the Seabed

Research and Development into Marine Biodegradable Plastics With a Degradation Initiation Switch

Fishing lines and broken fishing gear that sink to the seabed can remain there for hundreds or thousands of years without decomposing. There have been reports of harm coming to marine life that ingest these plastics, and they break down into microplastics that have negative impacts on the ecosystem, including posing a risk to humans when we eat seafood. This research is a response to the SOS signals our oceans are sending out. Our aim is to develop a new plastic that quickly decomposes and is rendered harmless in the ocean.



I Can't Ignore the Debris From Fishing I See All Over the Beach

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Many people enjoy fishing as a hobby, myself included. My love of fishing and the sea makes me concerned about the fishing lines, lures, and trash now littering the waters. Feeling that I had to take action, my team and I started work on a material that completely biodegrades in the marine environment through a switch that triggers biodegradation at the right time. Our research is grounded in extensive data collection, and as we near the end of this journey, I can almost hear the sound of clean, clear waves.

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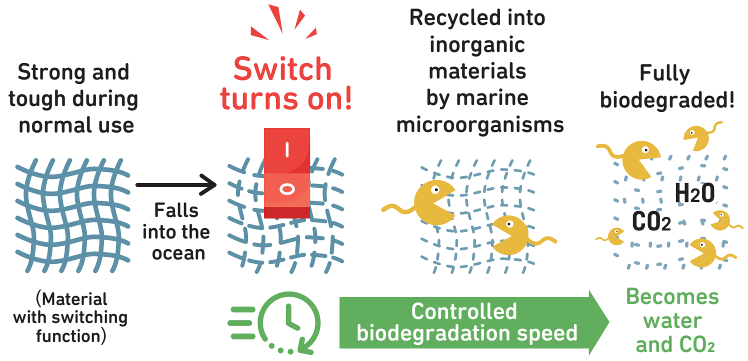
» Action Switches On When Plastic Reaches the Seabed

Biodegradable materials that lose strength with each use cannot be considered practical. Conversely, materials that can withstand the rigors of real-world use are not likely to biodegrade easily. An environmentally responsive switch function would combine these conflicting properties, and one switch we have discovered is triggered by the absence of oxygen. In oxygen-rich environments such as the ocean surface and midwaters, the strength of the polymer is maintained, but when the plastic reaches an oxygen-poor environment such as the muddy seafloor, this acts as a signal to start decomposition, and the material is broken down into smaller molecules.

» To Learn About the Ocean, Ask the Ocean!

Low molecular weight plastics can be broken down into tiny particles by enzymes that microorganisms produce, and when microorganisms then consume those particles, biodegradation is complete. In our research, we



conducted tests under a variety of conditions to analyze ***plastispheres***, which are the microbial communities living on plastic. We looked at the number and type of flora, what enzymes they produced, their metabolic mechanisms, and other aspects at the genetic level, using a device called a next-generation sequencer. The database built through testing in a wide range of marine environments, including the deep sea, is proving useful in making plastics that are easily consumed by microorganisms. We plan to create fishing materials made from plastics that feature switching functions to help solve the problem of polluted oceans.

KEYWORD

Plastisphere

It is the nature of microorganisms to attach to some kind of surface. The group of microorganisms that make plastic their home is called a plastisphere. Effectively managing the plastisphere plays a key role in promoting the biodegradation process.

FUTURE VISION

2025

Prepare to Incorporate Switches

We will test at least five types of degradation switches and establish technology to synthesize biomass-derived biodegradable substrate resins that incorporate at least three of them.

2027

Add Functionality and Head Towards Implementation

We aim to establish nine or more types of synthesis technology for new biodegradable polymer materials with functional switching technology. We will also collaborate with companies to prototype two types of substances that control the makeup of the plastisphere and promote real-world social implementation based on the research results.

2029

Continue to Improve Functionality

After the switching mechanisms are determined, we will develop at least three new plastics that exhibit 90 percent biodegradation after six months in seawater at 30°C. We will then demonstrate their biodegradability in the ocean, including the deep sea, and complete four prototypes with these switches using biomass and carbon-based materials.

Implementation	Gunma University, The University of Tokyo, Institute of Science Tokyo, Institute of Physical and Chemical Research (RIKEN), Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Project Introduction Video	https://www.youtube.com/watch?v=HUZI1udo3w0&list=PLZH3AKTCrVsVm3UN1x40WW_QK-cEXao03