Cellophane bees

Prelims: *Current events of national and international importance | Environment*

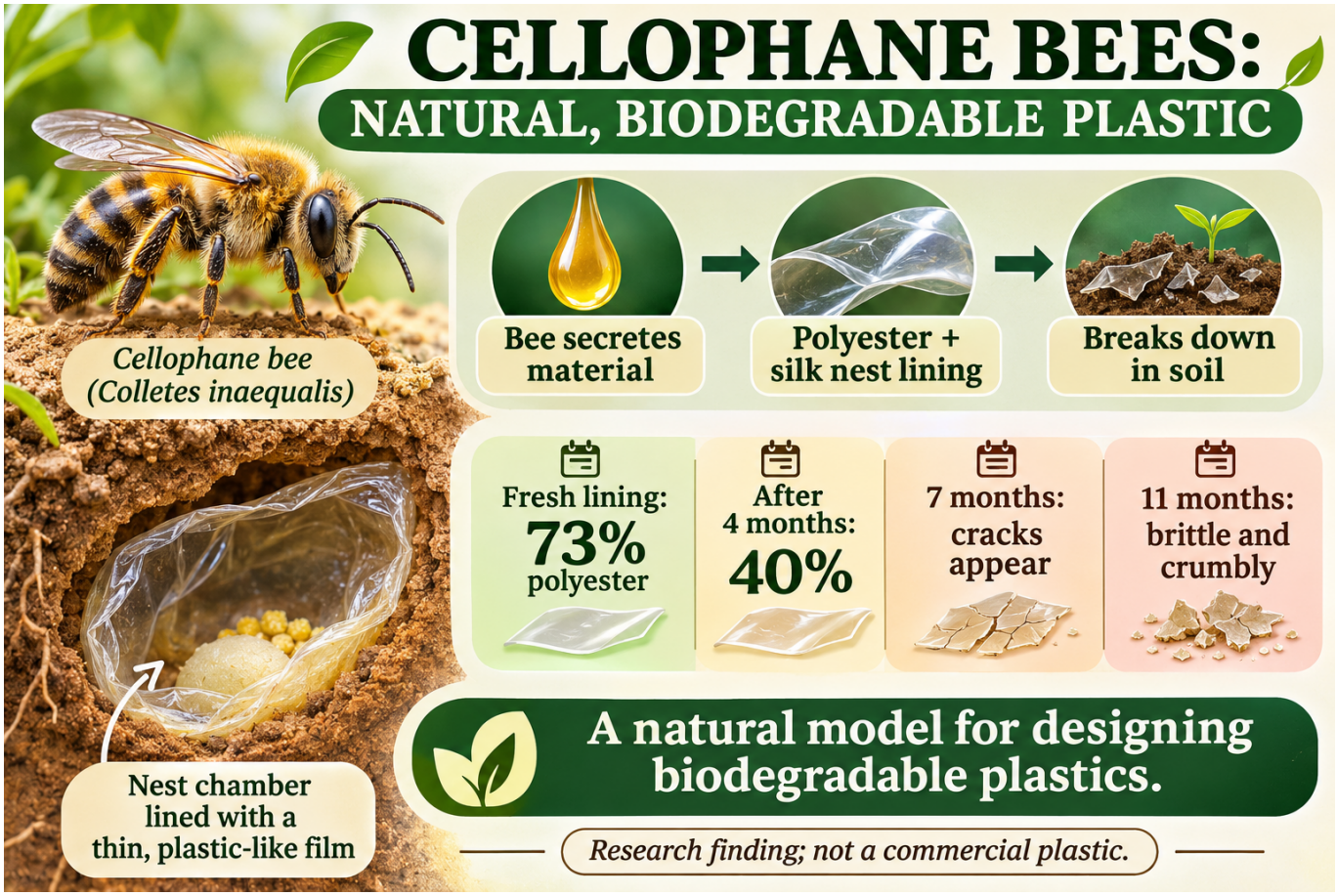
Why in News?

A recent study has revealed that cellophane bees produce a natural, polyethylene-like polyester to line their underground nests that rapidly biodegrades in ambient soil within a year.

Feature	Detail
Species Studied	*Colletes inaequalis* (commonly known as Cellophane Bees or Polyester Bees)
Nesting Behavior	Solitary, ground-nesting bees that dig underground tunnels and brood cells

Key Highlights

- The discovery provides a promising biomimetic blueprint for scientists trying to solve the global plastic pollution crisis by designing durable, water-resistant plastics that break down naturally without requiring industrial composting.
- **Natural Polymer Composition-** Female cellophane bees secrete a translucent, flexible, and waterproof film made of silk proteins and a semi-crystalline, cross-linked polyester to protect their underground brood cells from soil moisture and microbes.
- **Polyethylene-Like Properties -** Chemical and X-ray scattering analyses showed that the bee-made polyester mimics the molecular crystal structure and melting behavior of commercial **polyethylene**, a plastic notoriously resistant to breakdown.
- **Rapid Soil Degradation -** Unlike synthetic polyesters that persist for centuries, the nest lining's polyester content dropped from **73% to 40% within just 4 months** in natural soil.
- It began cracking by seven months, and crumbled completely within a year.
- **Mechanism of Breakdown -** Researchers suspect that the unique structural arrangement of the polymer exposes its ester bonds to water and natural soil enzymes (such as **esterases**), allowing microbes to cleave the chemical chains efficiently.



Biomimicry

- It is the practice of learning from and mimicking strategies found in nature to solve human design challenges.
- While scaling up bee farms to harvest plastic is impractical, reverse-engineering the exact molecular cross-linking of *Colletes* polyester could enable manufacturers to produce single-use packaging that performs like conventional polythene during use but safely decomposes in normal soil.

Polyethylene vs. Biodegradable Polyesters

- **Polyethylene (Polythene)-** A synthetic thermoplastic polymer made from ethylene monomers; its strong carbon-carbon backbone and high crystallinity prevent microbes from breaking it down.
- **Polyesters-** Polymers containing **ester functional groups** in their main chain, which are inherently more susceptible to hydrolysis and enzymatic cleavage if their crystalline packing permits moisture penetration.

Reference

The Hindu | Cellophane bees

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