



HIGH SCHOOL • GRADES 9–12 • AGES 14–18

From Science to Systems Thinking

STEM Curriculum Module

A four-unit curriculum bridging bioplastic chemistry, environmental data, business economics, and policy analysis — preparing students for STEM careers and conscious citizenship.

UNITS IN THIS MODULE

- 1 Unit 1: The Science of PHA Bioplastics
- 2 Unit 2: Microplastics — The Hidden Crisis
- 3 Unit 3: Sustainability in Business & Supply Chains
- 4 Unit 4: Environmental Policy & Plastic Legislation

Unit 1: The Science of PHA Bioplastics

Polyhydroxyalkanoates (PHA) are biodegradable polyesters produced through bacterial fermentation of plant-based feedstocks like canola oil. Students examine how microorganisms convert carbon sources into polymer chains with mechanical properties comparable to petroleum-based plastic.

KEY CONCEPTS

- Bacterial fermentation & polymer biosynthesis
- Monomer structure and molecular chain formation
- Comparative tensile strength: PHA vs. conventional plastic
- End-of-life decomposition pathways (soil, marine, industrial compost)

CLASSROOM DISCUSSION

Why might a bacterium "choose" to store carbon as a polymer? Connect this to energy storage strategies in other organisms, then discuss how industrial fermentation scales this natural process for manufacturing.

Unit 2: Microplastics — The Hidden Crisis

Data-driven exploration of microplastic contamination in water systems, soil, and human biology. Students connect lab chemistry to public health outcomes and evaluate policy responses using real environmental datasets.

DATA ANALYSIS EXERCISE

1. Review a sample dataset of microplastic particle counts across freshwater, marine, and soil samples.
2. Plot particle concentration by source category using a bar or scatter chart.
3. Identify which everyday product categories correlate most strongly with elevated readings.
4. Draft a one-paragraph policy recommendation grounded in the data.

VOCABULARY

Microplastic

A plastic fragment under 5mm, formed through degradation of larger plastic items.

Leachate

Liquid that has passed through waste, carrying dissolved contaminants.

Bioaccumulation

The gradual buildup of a substance within an organism over time.

Trophic transfer

Movement of a substance up the food chain from prey to predator.

Units 3 & 4

3

Sustainability in Business & Supply Chains

Case studies on how companies transition from single-use plastics to compostable alternatives. Students analyze real cost-benefit tradeoffs, brand positioning, and consumer behavior shifts.

4

Environmental Policy & Plastic Legislation

Overview of global plastic bans, Extended Producer Responsibility (EPR) regulations, and international agreements. Students debate policy approaches and their economic and ecological effectiveness.

PAIRS WELL WITH

- Case Study Collection (Unit 3 deep-dive)
- Debate & Discussion Guides (Unit 4 activities)

What Students Take Away

- Strong grasp of bioplastic chemistry and material science fundamentals
- Ability to analyze environmental data and evaluate policy
- Exposure to sustainability careers in science, business, and policy
- Research and presentation skills developed through project-based learning

NEXT STEPS FOR EDUCATORS

1. Pair this module with the Lab Activity: Bioplastic Properties
2. Assign the Case Study Collection for Unit 3
3. Run a Debate & Discussion Guide session for Unit 4

Questions? help@pureformsolution.com