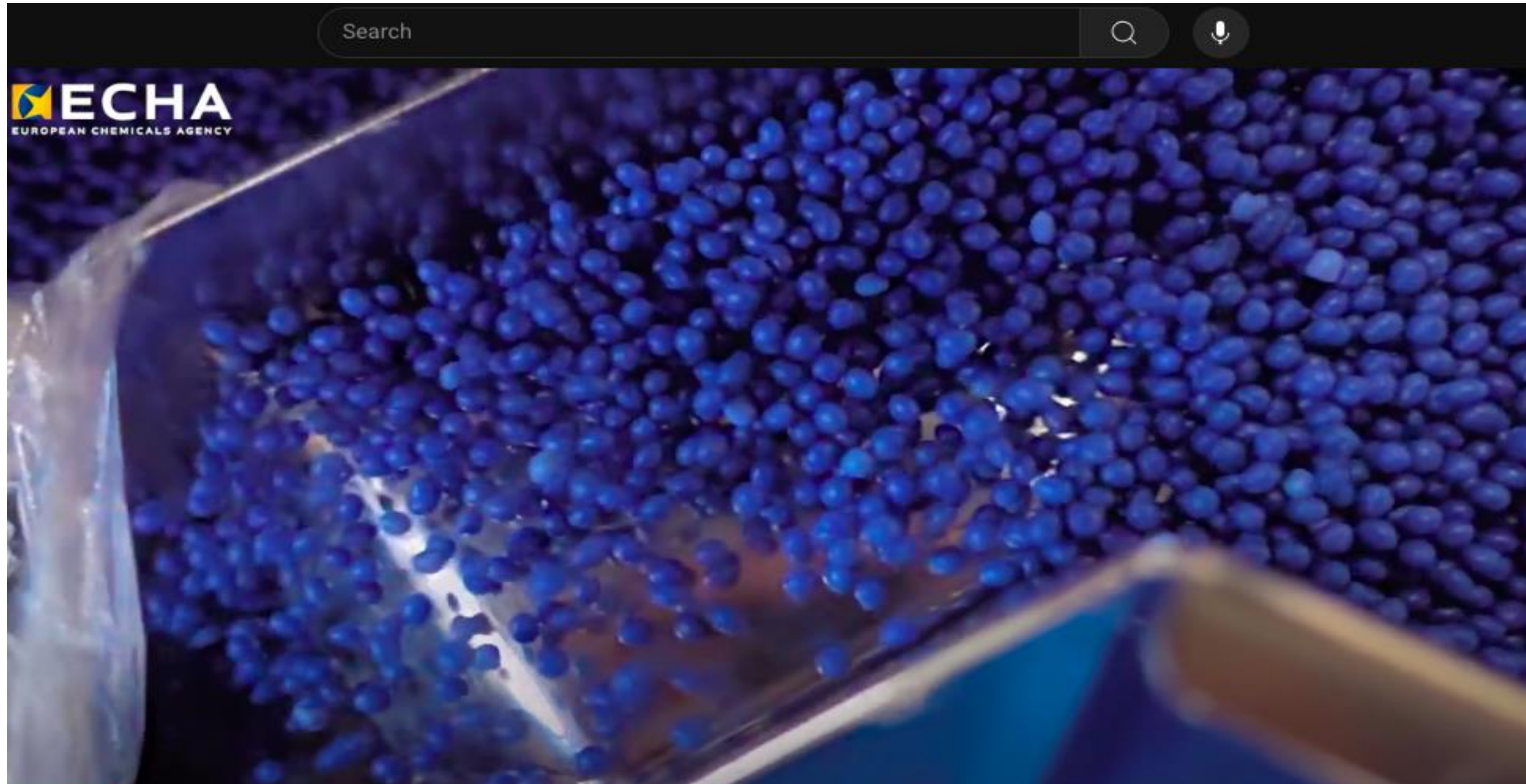# MICROBIAL DEGRADATION OF PLASTIC

A Viable Solution or Overhyped Promise

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Dean of School of Languages, TTU

Watch this video clip about MICROPLASTICS

https://www.youtube.com/watch?v=sl82ZO9AT4Y

1. **Microplastics are**:
A. Only found in large pieces of plastic.
B. Always visible to the naked eye.
C. Smaller than five millimeters in size.
D. A type of bacteria.

2. One of the main sources of microplastic pollution is:
A. Natural erosion.
B. Synthetic clothing.
C. Plant-based products.
D. Metal manufacturing.

3. The primary concern about microplastics is:
A. Their potential to cause global warming.
B. Their unknown impact on the environment and possibly humans.
C. Their contribution to ozone depletion.
D. Their effect on the economy.

4. The primary benefit of microplastics is:
A. Their low cost of production.
B. Their ability to biodegrade quickly.
C. Their versatility in various applications.
D. Their harmless nature to the environment.

5. A major challenge in addressing microplastic pollution is:
A. The lack of public awareness.
B. The difficulty in tracking microplastics in the environment.
C. The absence of international regulations.
D. All of the above.

6. The European Union's response to microplastic pollution includes:
A. Ignoring the issue due to economic concerns.
B. Promoting the use of microplastics in new products.
C. Investigating the risks and potential regulations for microplastics.
D. Encouraging the public to consume more plastic products.

7. A potential consequence of restricting microplastics in products is:

A. Increased profits for the plastics industry.

B. The need for companies to develop alternative materials.

C. A decrease in product quality.

D. No significant impact on the industry.

8. The speaker's perspective on a total ban on microplastics is:

A. Supportive.

B. Indifferent.

C. Negative.

D. Uncertain.

QUESTIONS

1. What do you know about microbes? Can you give examples of different types of microbes?

2. How do you think microbes could contribute to making these practices more sustainable?

3. Can you think of any industries or areas where microbial solutions might be particularly useful for reducing environmental impact?

4. What are some challenges you think might arise when using microbes for eco-friendly solutions? How do you think these challenges can be overcome?

5. How important do you think it is to find sustainable alternatives to traditional plastics? Why?

6. Can you think of any questions you have about microbes, plastic pollution, or eco-friendly solutions that you hope to learn more about?

Microbes

- **Definition:** Microbes, short for microorganisms, are tiny living organisms that are too small to be seen with the naked eye.
- **Microbial Diversity:** Microbes are incredibly diverse, with millions of species found in various habitats worldwide.
- **Types of Microbes:** Bacteria living in soil, fungi in forests, viruses in oceans, protists (typically single-celled organisms, such as amoebas, paramecia, algae, etc. , living in aquatic environments such as oceans, lakes, and rivers, as well as moist terrestrial habitats like soil and decaying organic matter).

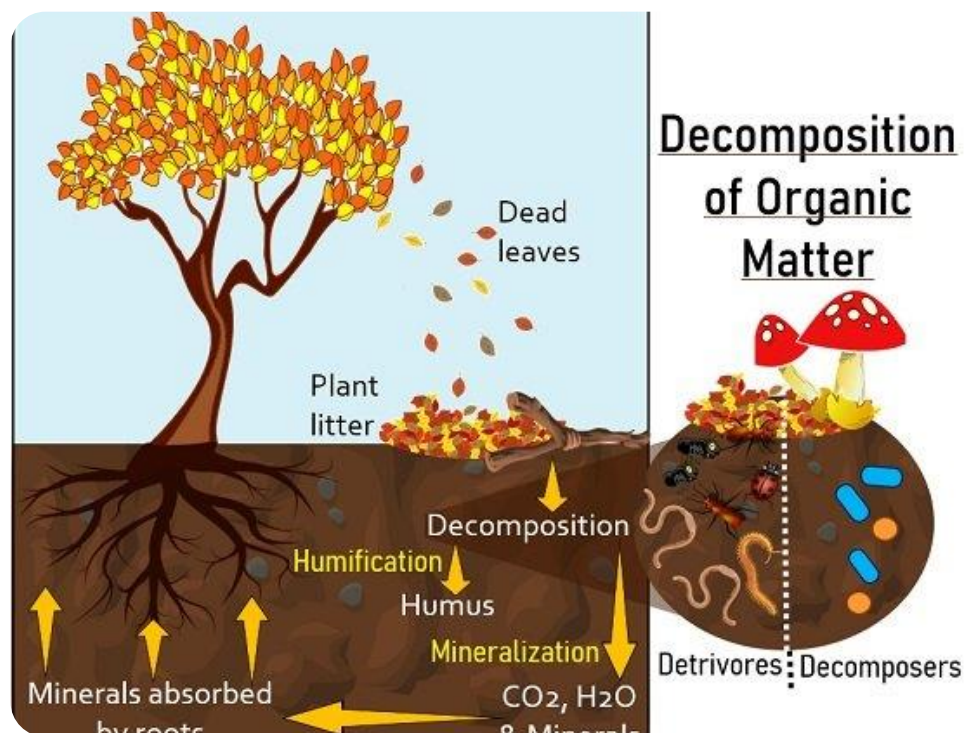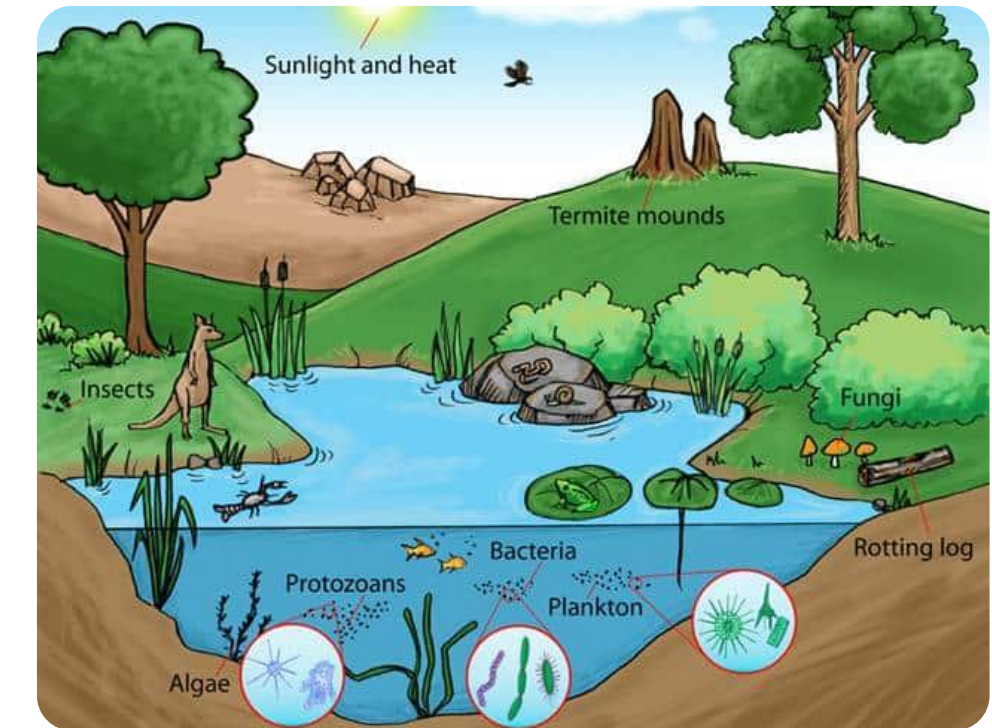# IMPORTANCE OF MICROBES IN ECOSYSTEMS

Key Players in Ecosystems

Microbes play crucial roles in maintaining ecosystem health and function. Understanding microbial ecology is crucial for predicting and mitigating the effects of environmental changes, such as climate change and pollution.

Decomposition

Microbes break down organic matter, recycling nutrients and returning them to the environment.
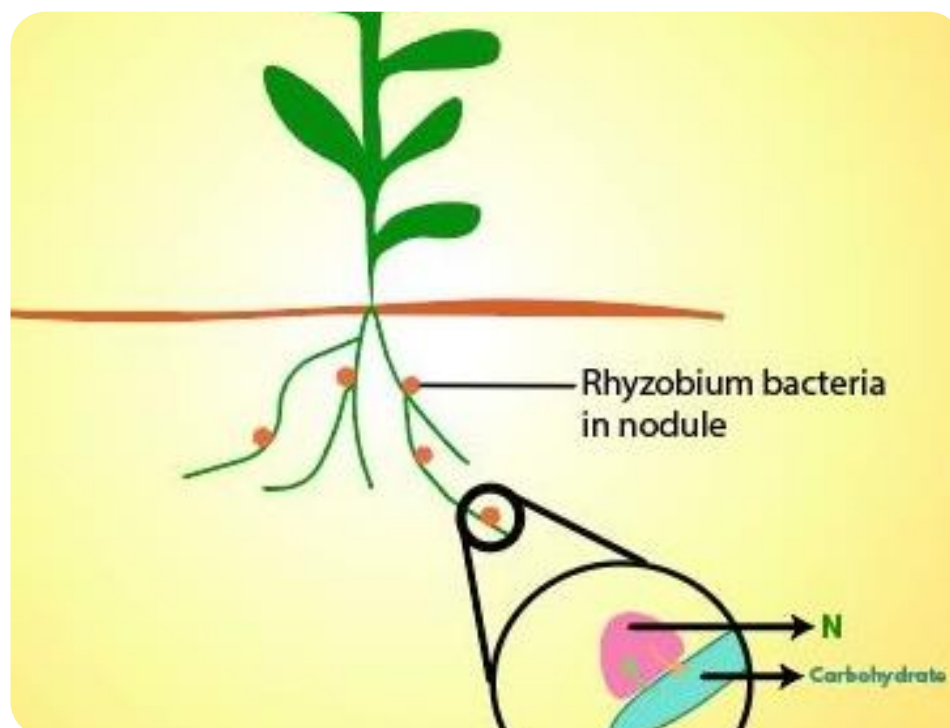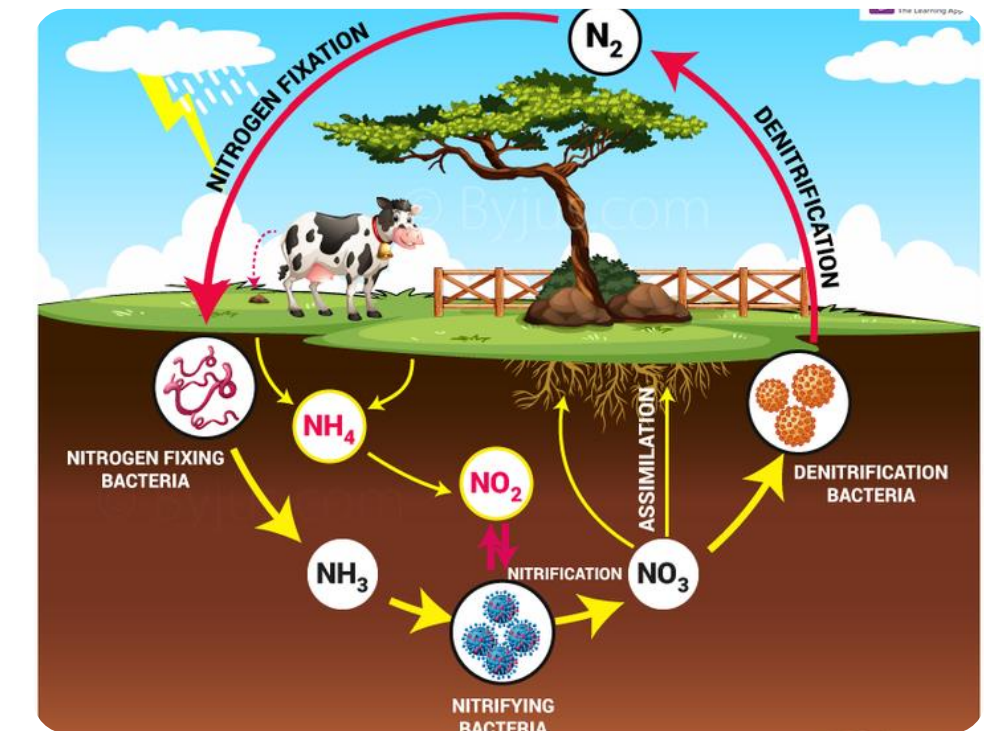
IMPORTANCE OF MICROBES IN ECOSYSTEMS

Nutrient Cycling

Microbes are involved in the cycling of carbon, nitrogen, phosphorus, and other essential elements.

Symbiotic Relationships

Microbes form symbiotic relationships with plants and animals, aiding in digestion, nitrogen fixation, and disease prevention.

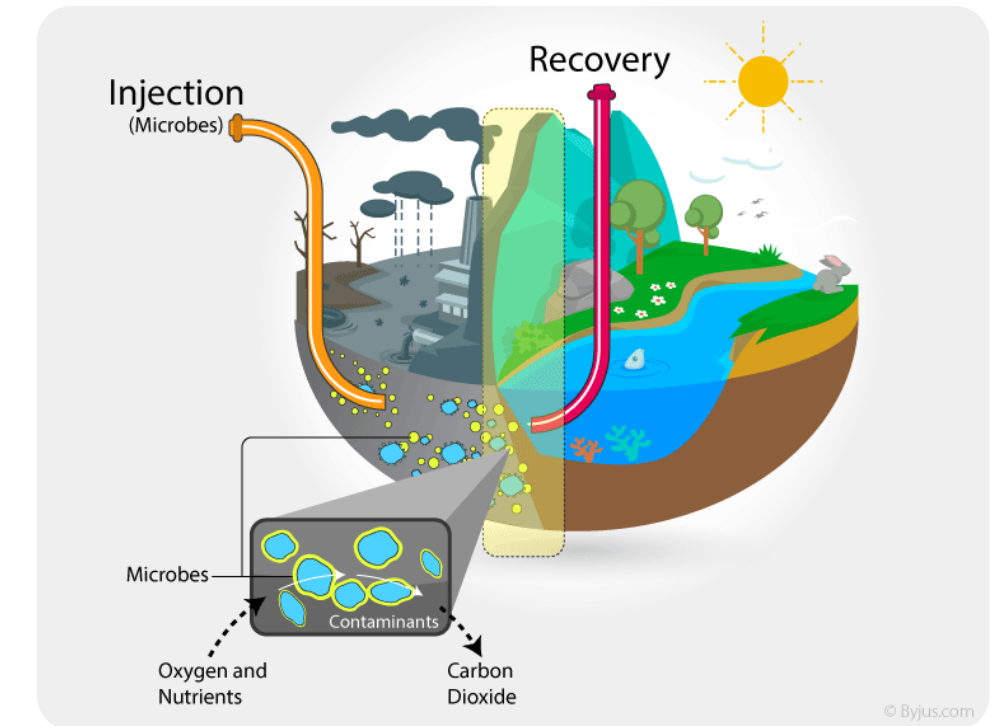# IMPORTANCE OF MICROBES IN ECOSYSTEMS

Biotechnological Applications

Knowledge of microbial interactions and functions can be harnessed for bioremediation, agriculture, medicine, and other applications.

Examples of microbial-based solutions for environmental challenges

Microbial plastic degradation for plastic pollution, bioremediation for cleaning up contaminated sites, microbial fuel cells for renewable energy production, and microbial water treatment for purifying wastewater.
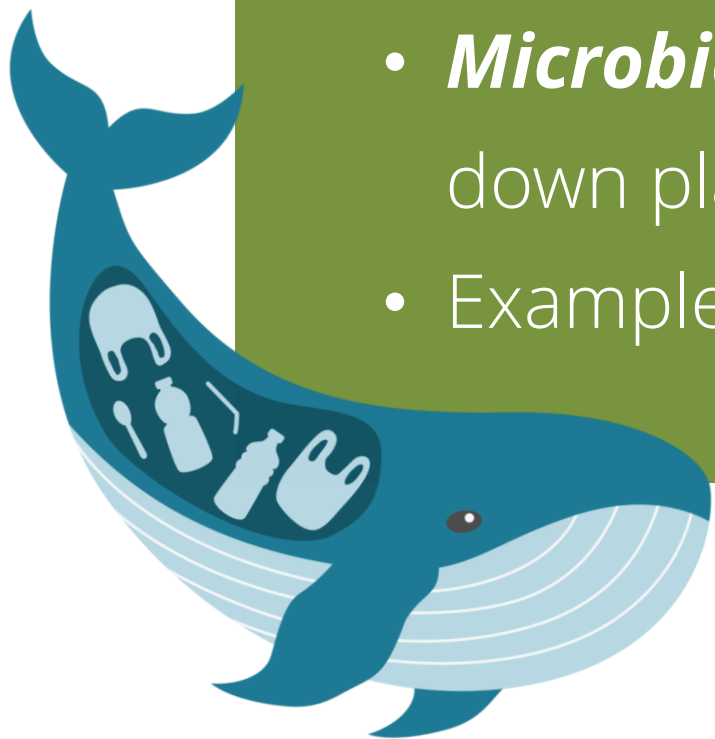
Plastic Degradation and Microbial Plastic Degradation

- Plastic pollution is a significant environmental challenge worldwide.
- Microbes offer a promising solution through their ability to degrade plastic and mitigate plastic pollution and environmental damage.
- **Microbial plastic degradation** refers to the ability of certain microorganisms to break down plastic polymers into simpler compounds.
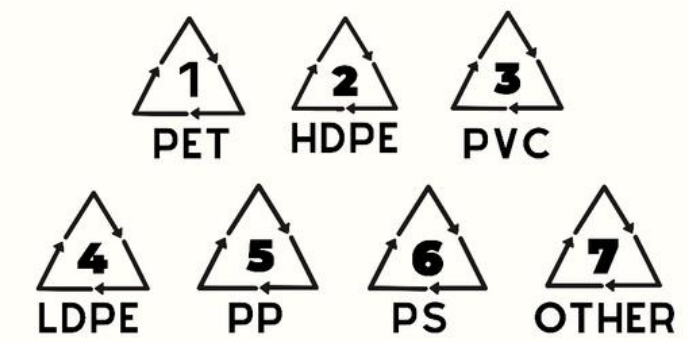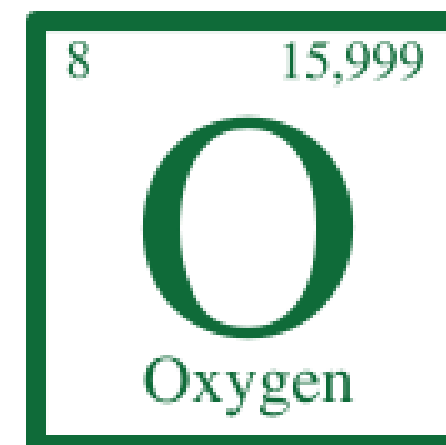- Examples of plastic-degrading microbes: bacteria, fungi,...
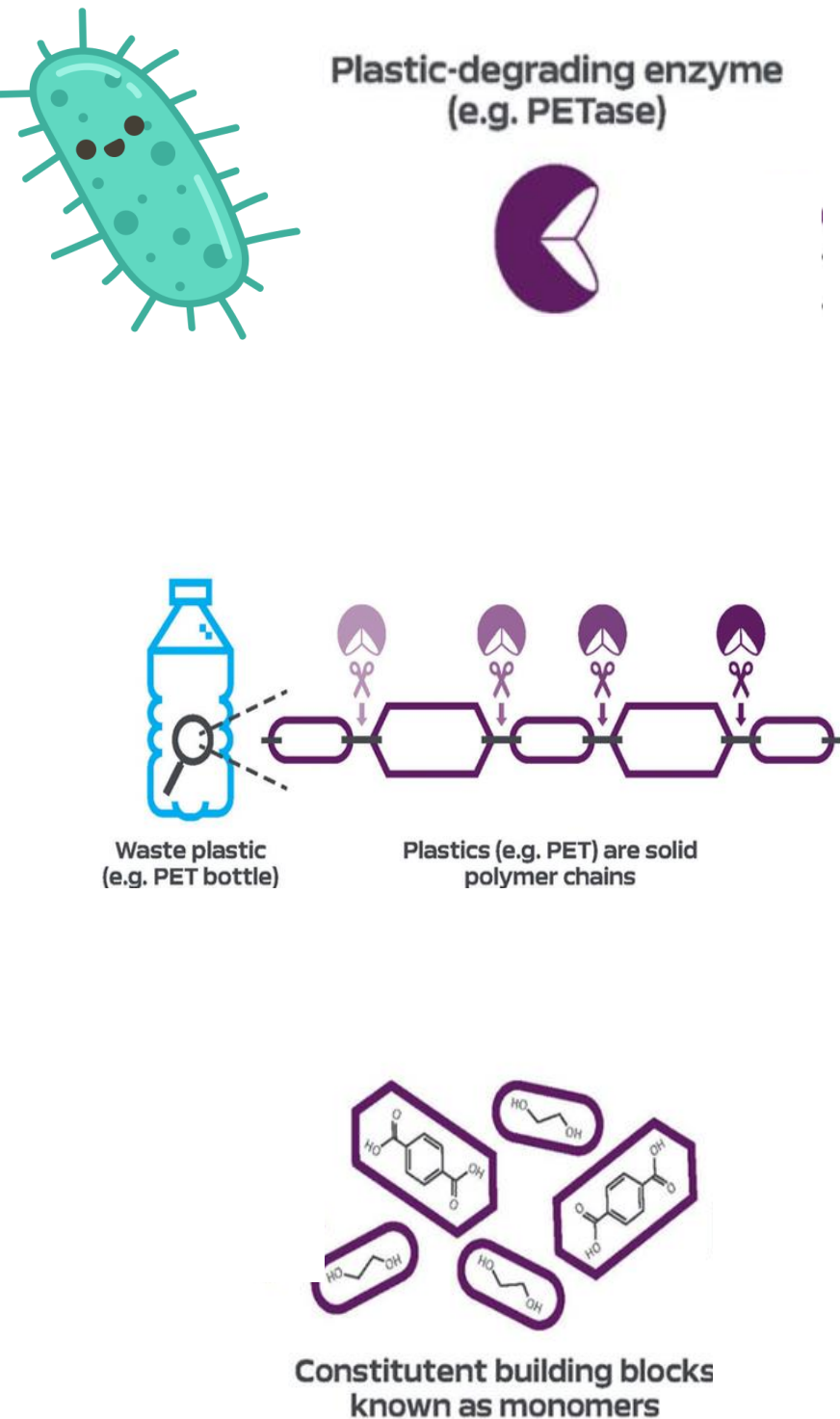
FACTORS INFLUENCING DEGRADATION

- **Temperature, pH, and oxygen availability affect microbial activity and plastic degradation rates.**

- **Plastic composition and structure influence susceptibility to degradation.**

PROCESS

Plastic-degrading enzyme
(e.g. PETase)

Waste plastic
(e.g. PET bottle)

Plastics (e.g. PET) are solid
polymer chains

Constitutent building blocks
known as monomers

- **Microbes produce enzymes that break down plastic polymers.**

- **Enzymes initiate biochemical reactions that cleave chemical bonds in plastic molecules.**

- **Breakdown products are typically smaller compounds that can be metabolized by microbes.**

PLASTIC WASTE REDUCTION

Plastic Degradation:

Utilizing microbial processes to degrade plastic waste in landfills, oceans, and other environments.

Environmental Benefits:

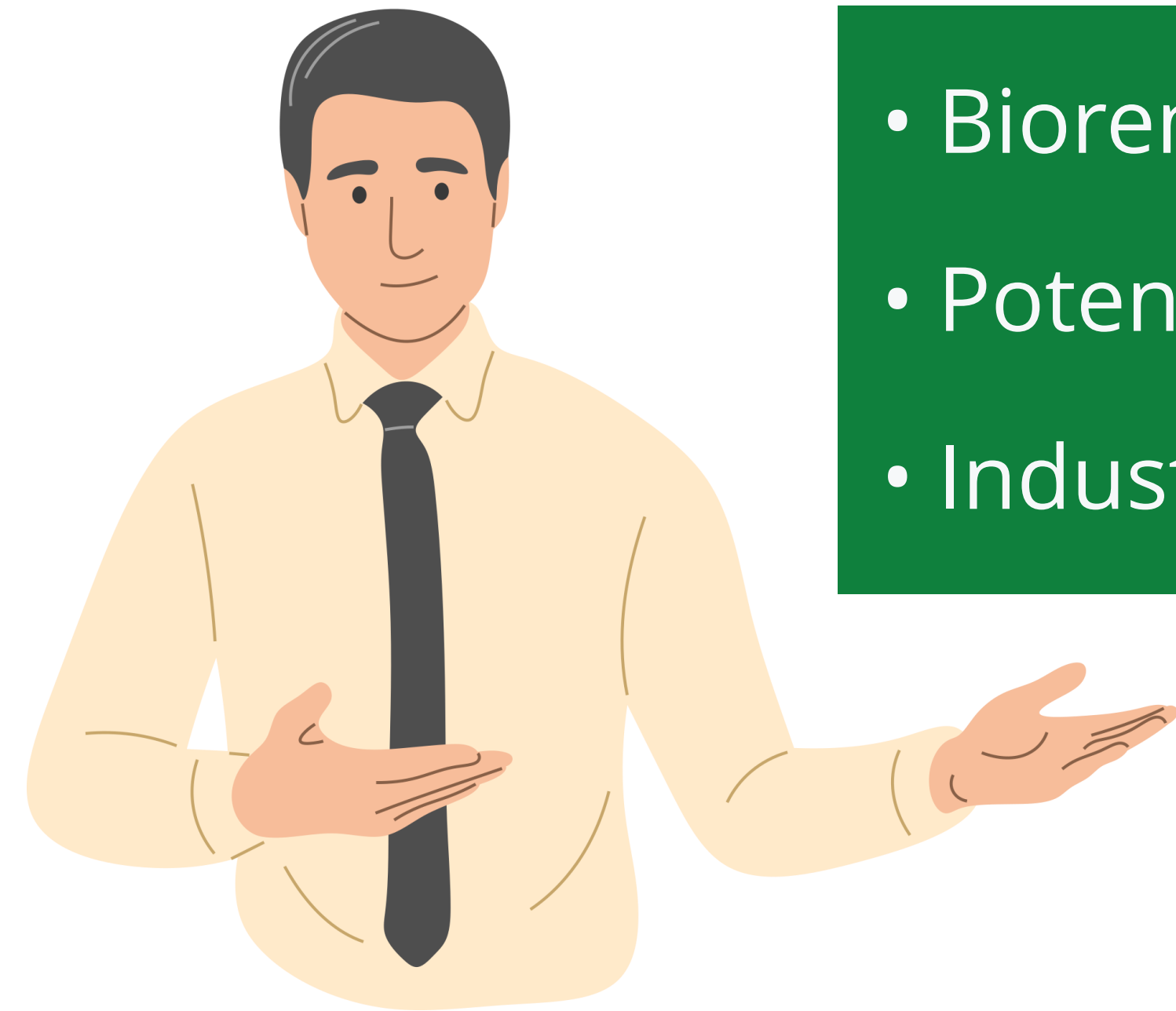Reduced plastic accumulation, prevention of environmental contamination, and ecosystem preservation.

APPLICATIONS OF MICROBIAL PLASTIC DEGRADATION

- Bioremediation of plastic waste in landfills
- Potential for cleaning plastic pollution in oceans
- Industrial applications in recycling

Bioremediation of plastic waste in landfills
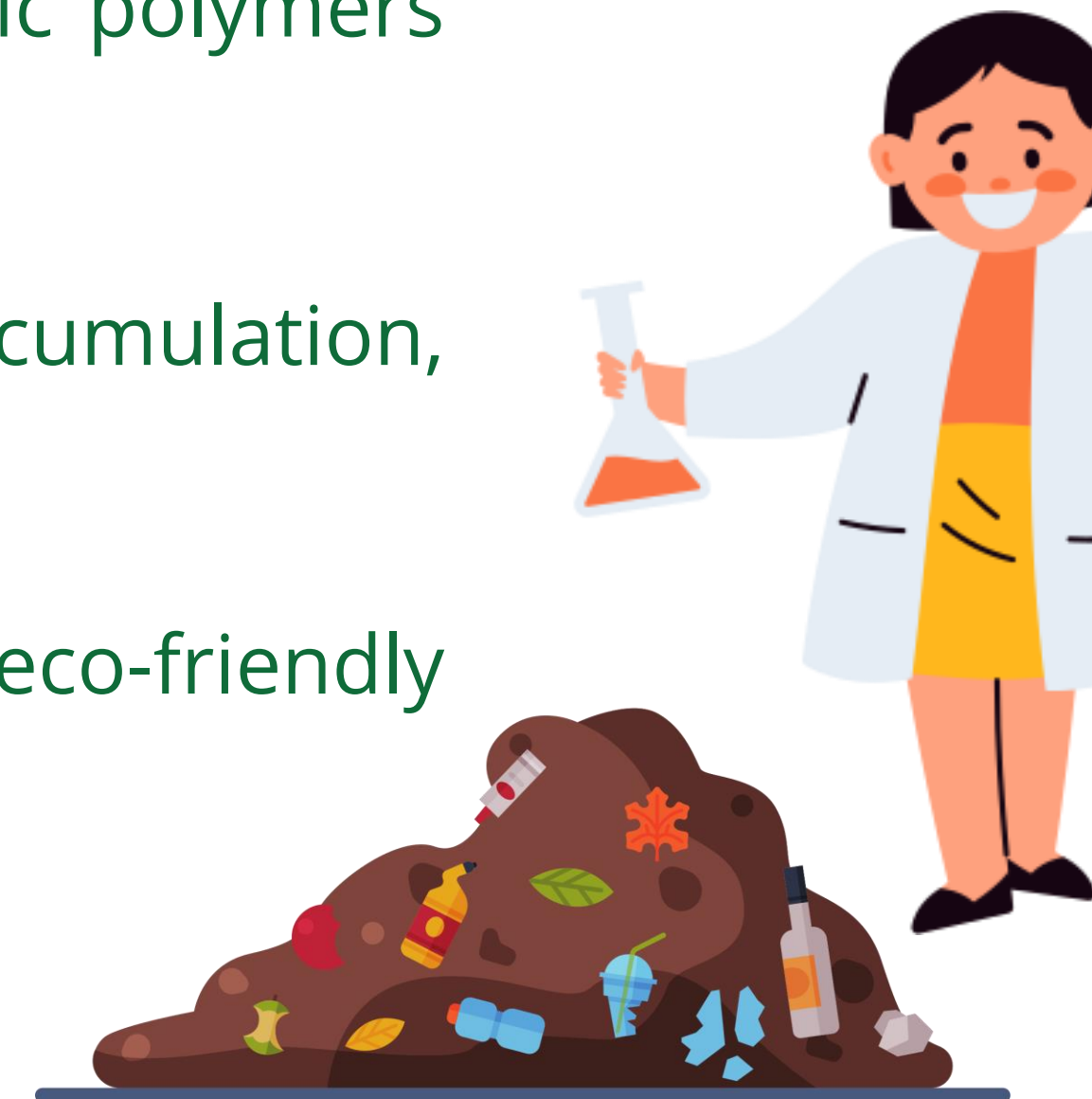
- **Microbial Processes:** Microbes enzymatically degrade plastic polymers in landfill sites.

- **Environmental Benefits:** Bioremediation reduces plastic accumulation, preventing soil and groundwater contamination.

- **Sustainable Solution:** Microbial degradation offers an eco-friendly approach to managing plastic waste in landfills.
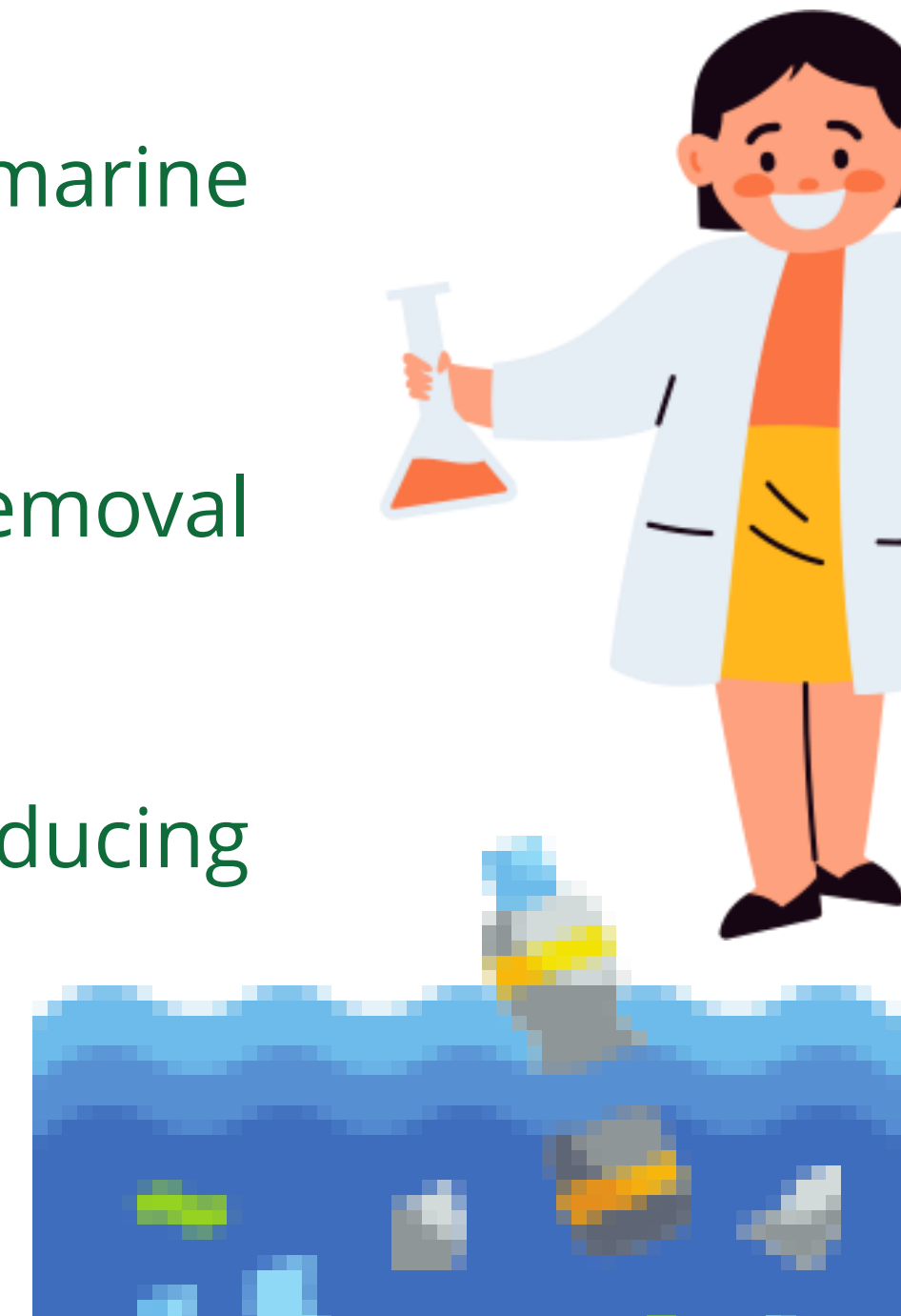
Potential for Cleaning Plastic Pollution in Oceans

- **Marine Biodegradation:** Microbes naturally occurring in marine environments degrade plastic debris.

- **Ocean Cleanup:** Microbial-based solutions contribute to the removal and decomposition of plastic waste in oceans.

- **Environmental Impact:** Microbial plastic degradation aids in reducing marine pollution and preserving marine ecosystems.

Industrial Applications in Recycling

- **Plastic Recycling:** Microbial degradation processes can be integrated into industrial recycling systems.

- **Waste Management:** Microbial-based technologies offer sustainable solutions for recycling plastic waste.

- **Circular Economy:** Incorporating microbial plastic degradation promotes the transition towards a circular economy by closing the loop on plastic production and consumption.

ENVIRONMENTAL IMPACT

- **Sustainable Solutions:** Microbial plastic degradation offers a sustainable and eco-friendly approach to addressing plastic pollution.
- Contribution to the reduction of plastic waste accumulation in the environment.
- **Eco-Friendly Practices:** Adoption of microbial-based solutions promotes sustainability and environmental stewardship (ecological responsibility).
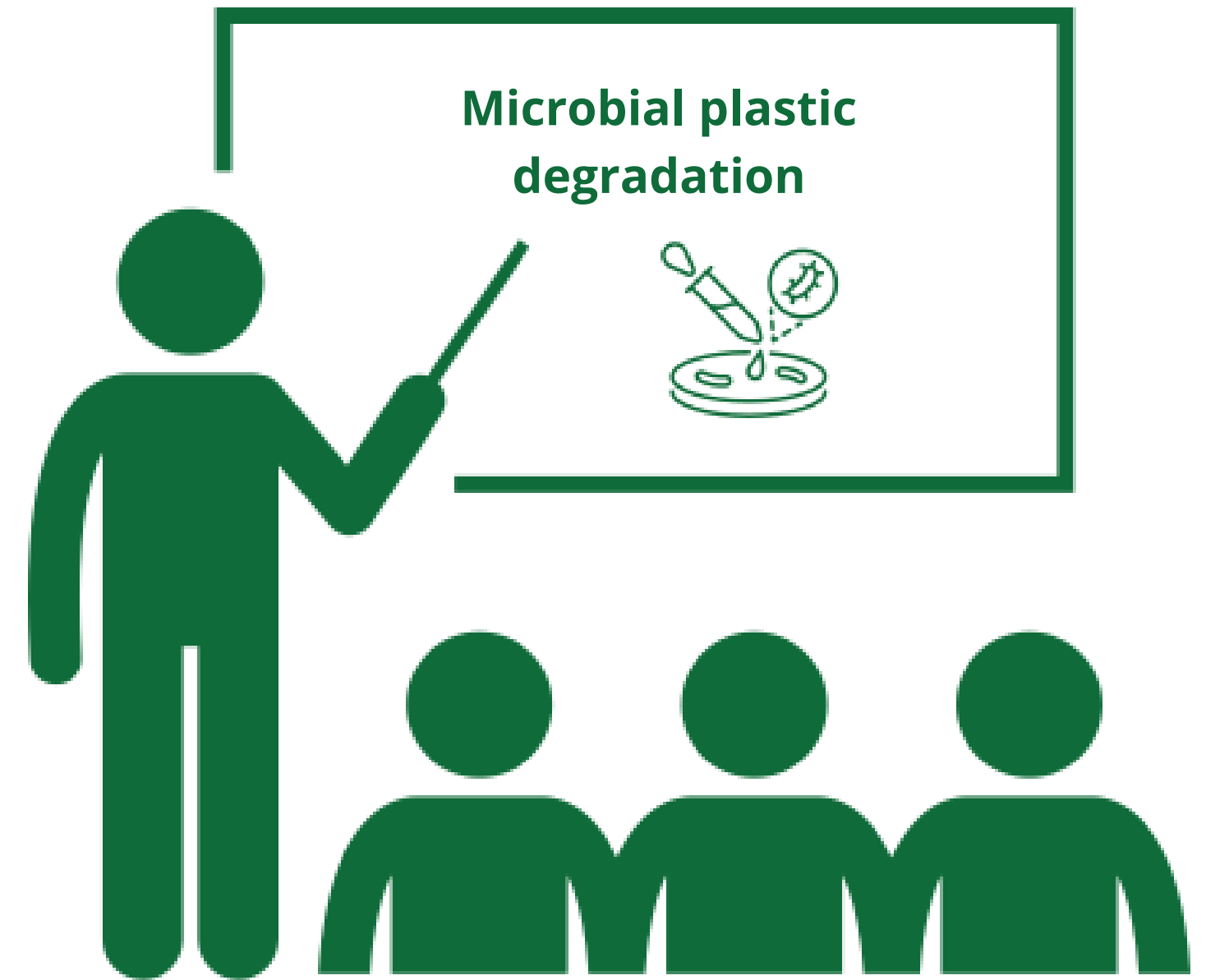
CONSUMER AWARENESS

- **Education and Outreach:** Importance of raising awareness about the environmental benefits of microbial plastic degradation.
- **Consumer Choices:** Encouragement for consumers to support eco-friendly products and practices.

Microbial plastic degradation

CHALLENGES AND FUTURE DIRECTIONS

- **Limitations of microbial applications**
- **Research and development opportunities**
- **Potential for scaling up microbial solutions**

Topic 1: Microplastic Pollution Degradation: A Viable Solution or Overhyped Promise

1) Viable solution
2) Overhyped promise

Topci 2: Single-Use Plastics: Ban or Tax
1) Ban
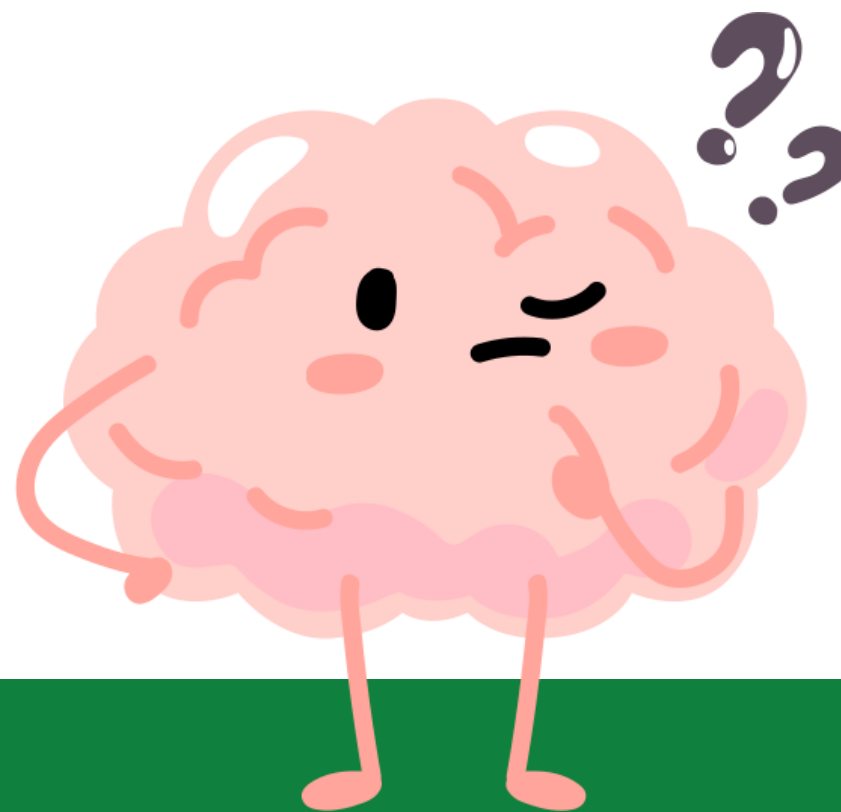2) Tax

Topic 3: Plastic Recycling: Myth or Reality
1) Myth
2) Reality

QUESTIONS

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4. Ward, D.M., Ferris, M.J., Nold, S.C., & Bateson, M.M. (1998). A natural view of microbial biodiversity within hot spring cyanobacterial mat communities. Microbiology and Molecular Biology Reviews, 62(4), 1353-1370.
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THANK YOU

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Scientific English Immersion with Hands-on Experimentation on Microbial Plastic Degradation in Vietnam