



**RUTGERS**

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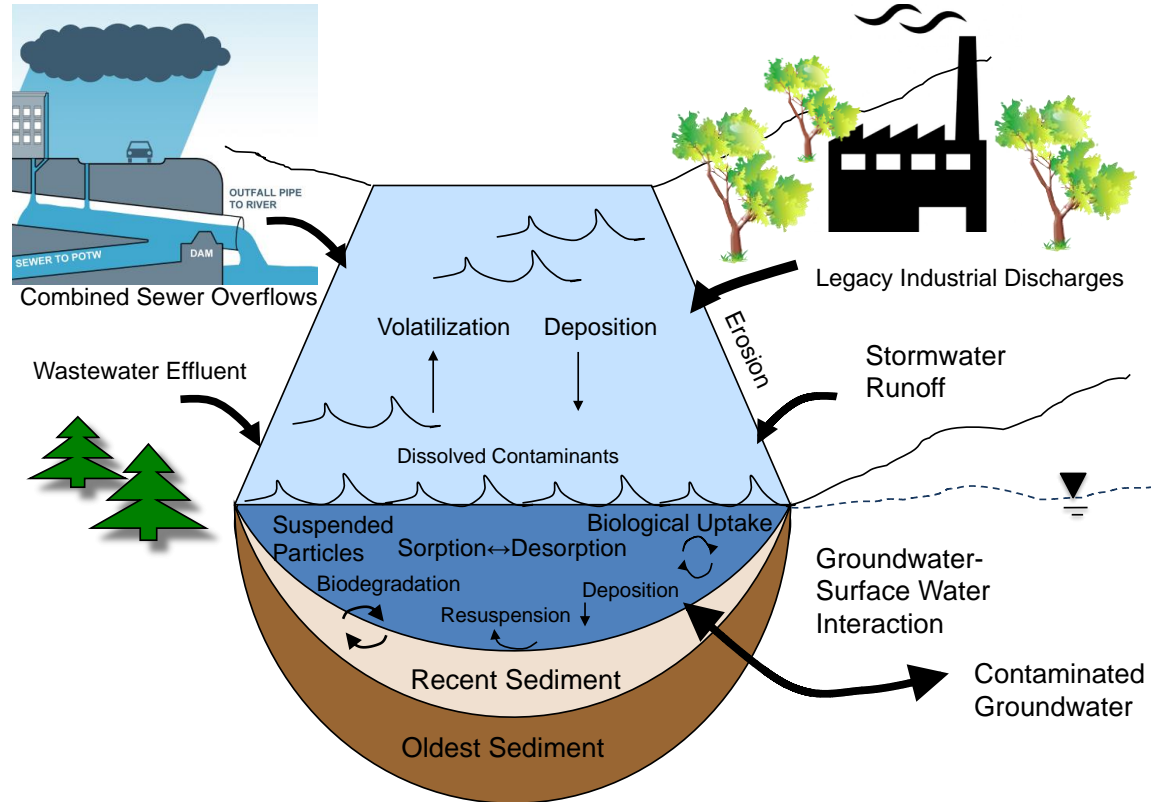
# **Bioremediation and Emerging Contaminants**

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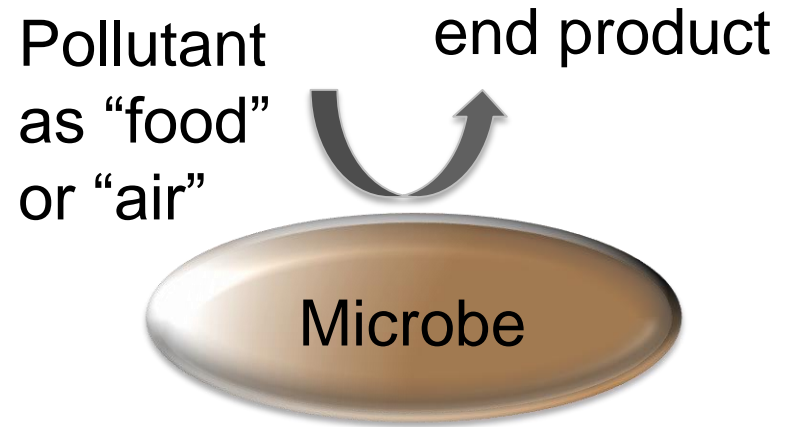
# Emerging and Legacy Pollutants

- Historical discharges
- Sorbed to sediments, transported throughout the estuary
- Input from contaminated sites
- Stormwater, wastewater effluent, and combined sewer overflows



# Bacteria Biodegrade Pollutants

- Biodegradation occurs naturally
- Biodegradation can be enhanced as part of a bioremediation process
- **Bioremediation** is a viable technical solution for some pollutants
- Application in riverine systems is less common than for soils or groundwater aquifers



# Biodegradation/Bioremediation

## When it is “complete”

- original pollutant is completely degraded or transformed
- the breakdown product (metabolite) is non-toxic
- the metabolite is known

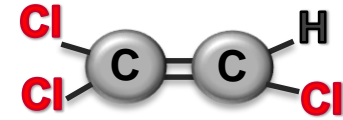
## When it is “incomplete”

- original pollutant remains
- the breakdown product (metabolite) is toxic
- the metabolites are unknown and/or not monitored

# Biodegradation/Bioremediation

Anaerobic transformation of halogenated organic compounds (Organohalides)

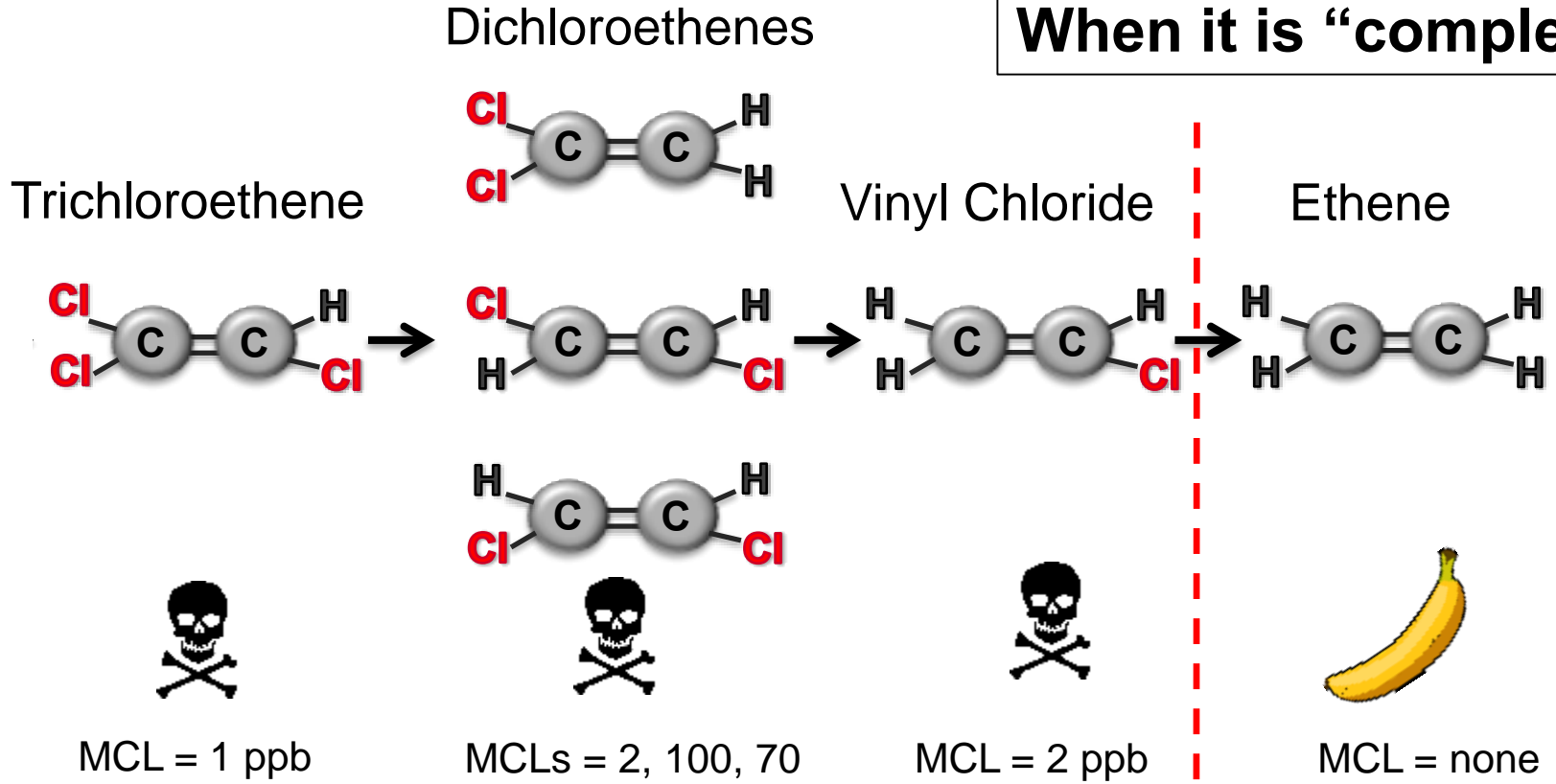
- Organohalides are/were widely used in industry
- Organohalides are common environmental pollutants
- Dehalogenation occurs in the absence of oxygen
- Dehalogenating bacteria “breathe” using the halogen-carbon bond



Trichloroethene

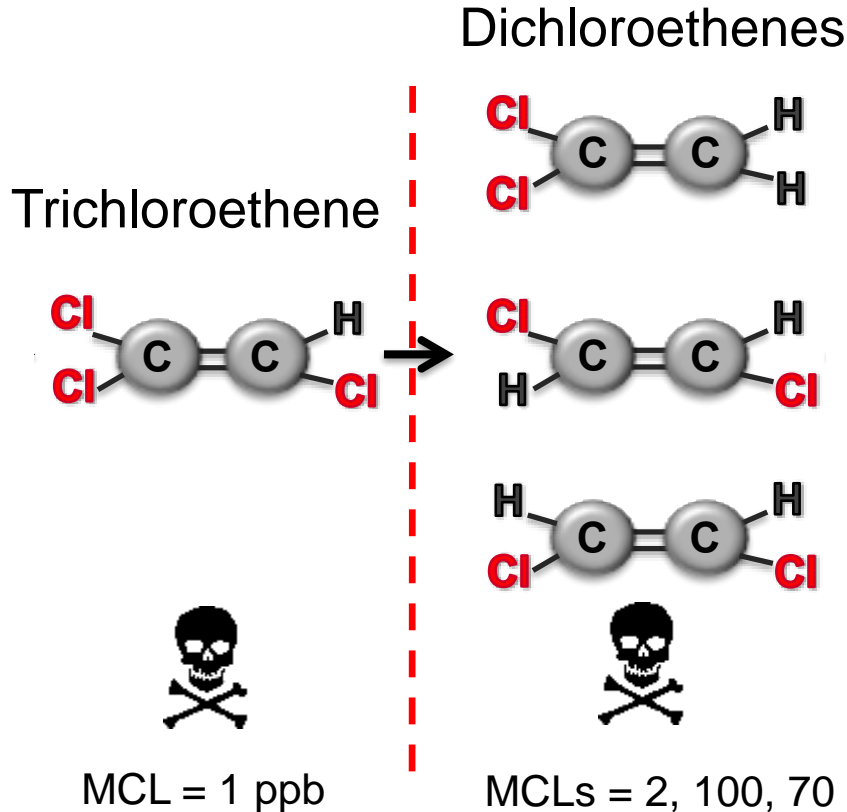
# Biodegradation/Bioremediation

When it is "complete"

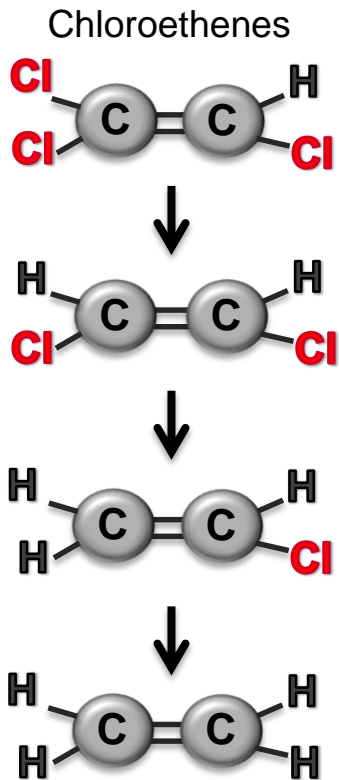


# Biodegradation/Bioremediation

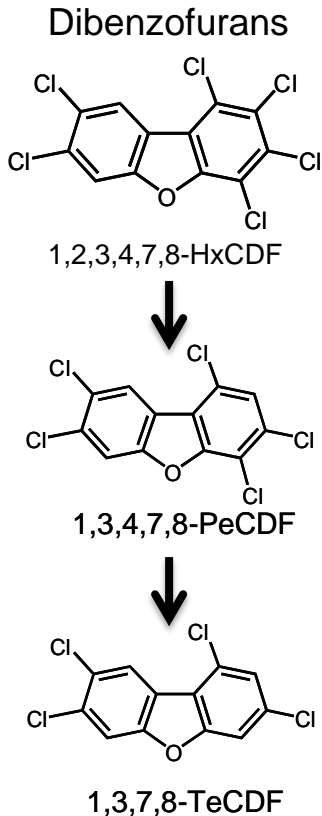
When it is “incomplete”



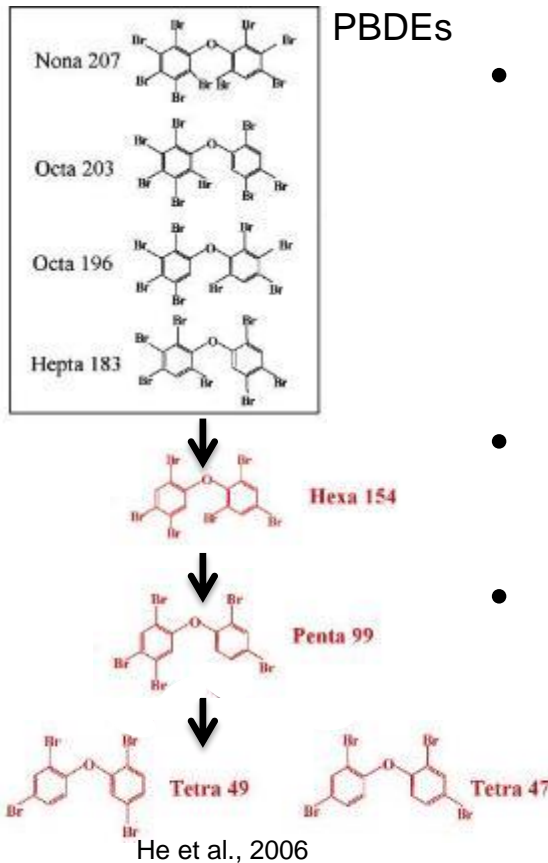
# Parallels for Different Contaminant Classes



Freedman & Gossett 1989



Liu & Fennell, 2008

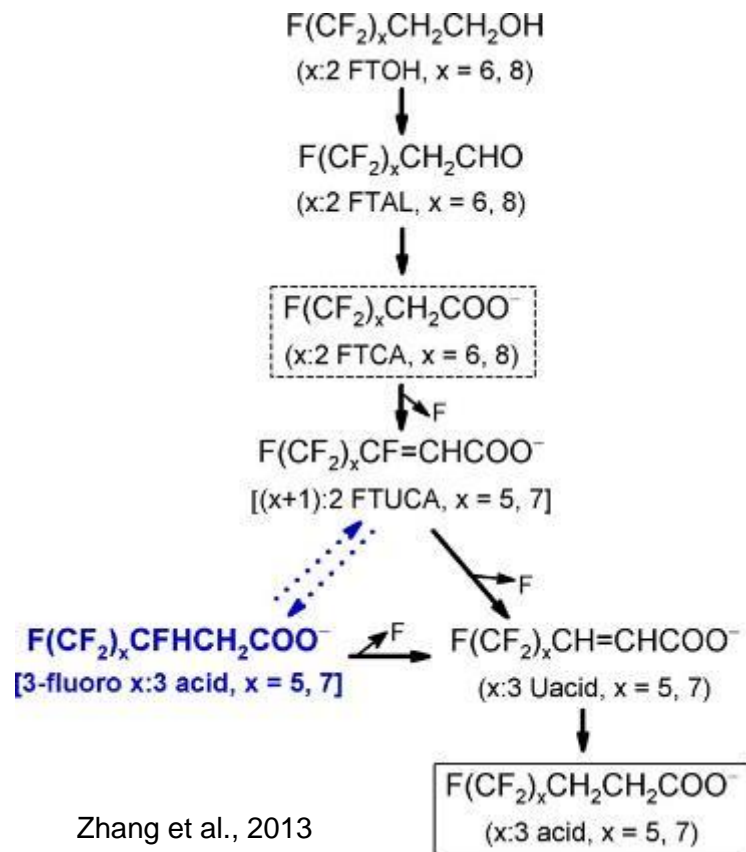


- All these reactions are mediated by the same bacterial species
- Different enzymes
- Synergistic interactions



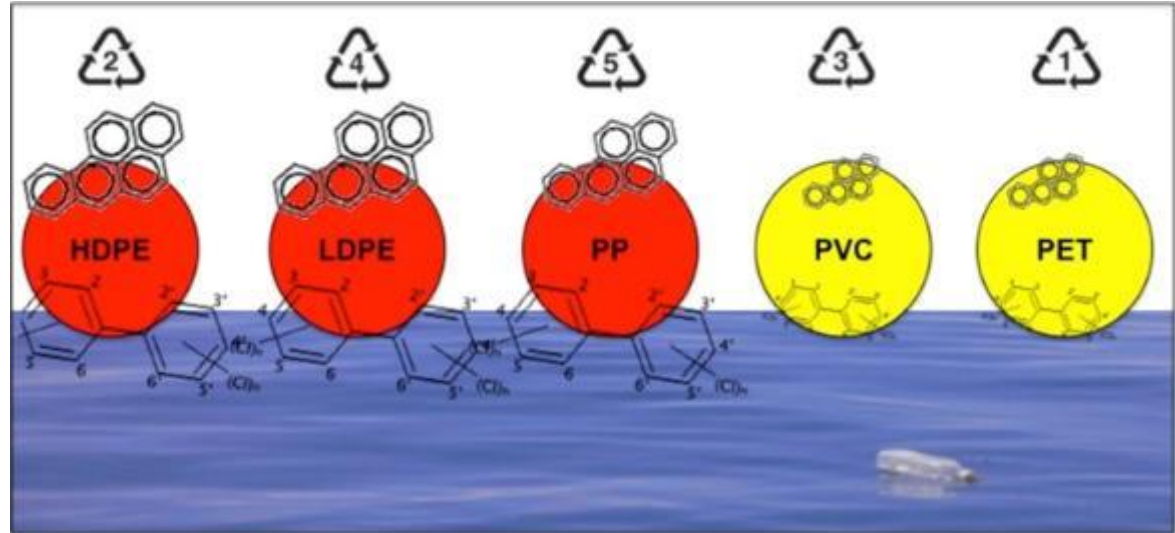
# Parallels for Emerging Contaminants

- Perfluoroalkyl Acids
  - C-F bond energetically stable
  - Biotransformation mainly of carbon side chain
  - Defluorination is rare and highly fluorinated chains are resistant
  - We do not know what types of microbes are active
  - Research still in early stages



# Interactions Between Legacy and Emerging Contaminants

- Legacy pollutants or metabolites sorb to microplastics
- Pollutants are concentrated
- Does this provide a bigger driving force for biodegradation?



Rochman et al., 2013, Environ. Sci. Technol. 47, 3, 1646-1654