Lecture 7: Pollution Fate and Transport: How Contaminants Move Through the Environment

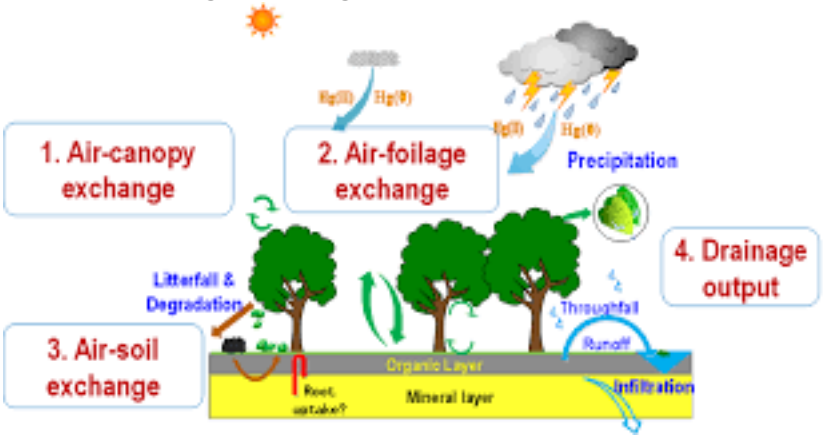
A Course in Fundamental of Pollution

Lecture 7: Pollution Fate and Transport: How Contaminants Move Through the Environment

Core Concept: Tracing the pathways and transformations of pollutants from source to sink.

(Introduction)

"A pollutant released in one place does not simply stay there. It embarks on a journey through the environment—a journey governed by the laws of physics, chemistry, and biology. Understanding **fate and transport** is essential for predicting exposure, designing monitoring programs, and engineering effective cleanups.

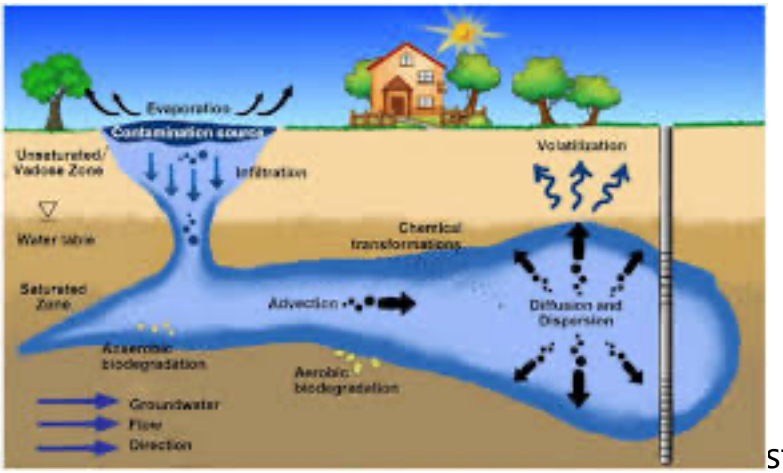


The journey involves several key processes:

- **Advection:** The physical transport of the pollutant by the movement of the medium itself (e.g., a plume of contaminated groundwater moving with the flow of the aquifer, or smokestack emissions carried by wind).
- **Dispersion:** The spreading and dilution of the contaminant plume due to turbulence and variations in velocity within the medium.
- **Partitioning:** How a pollutant distributes itself between different phases (e.g., between water and air, water and soil, or water and

organic tissue). This is determined by properties like volatility and solubility we discussed earlier.

- **Transformation:** The alteration of the parent compound into daughter products through:
    - **Abiotic Reactions:** Hydrolysis, oxidation, reduction, and photolysis (breakdown by sunlight).
    - **Biotic Reactions:** Degradation by microorganisms (biodegradation).



We use sophisticated mathematical models to simulate these processes. For instance, we can model how a VOC spill will partition into soil, groundwater, and soil gas, or how an air pollutant will disperse from a factory based on prevailing winds and weather conditions. This predictive power is the bedrock of environmental risk assessment."