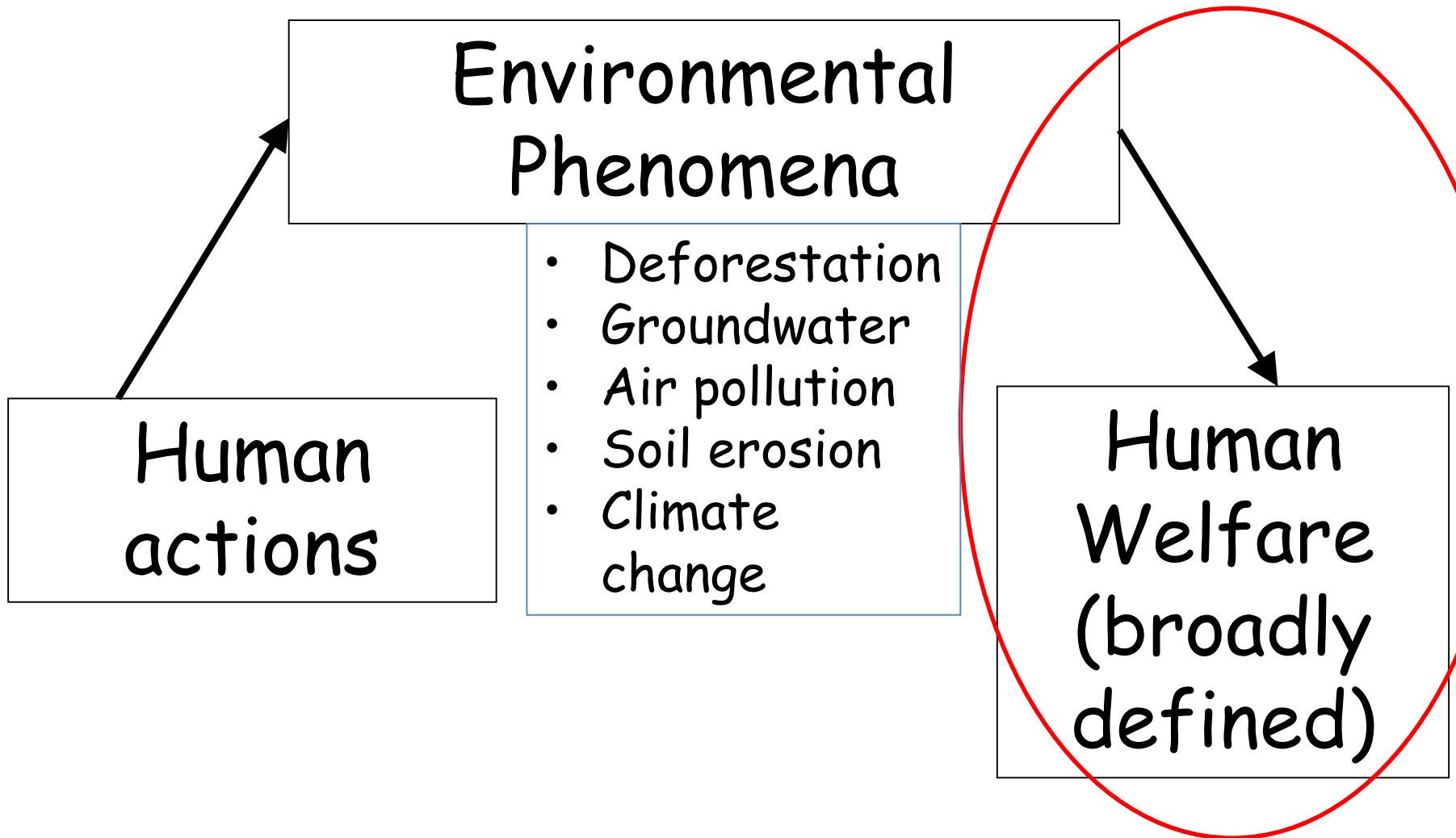


# ASSESSING OUTCOMES

# Nature of environmental problems



# Health Risk assessment

# Why does a nation have water quality standards ?

- Prevent human health impacts
- Prevent ecological health impacts

Acceptable  
risk/health impacts  
(because zero is  
impossible)

- Level of human and/or material injury or loss from an industrial process that is considered to be tolerable by a society or authorities in view of the social, political, and economic cost-benefit analysis
- How do we set this standard?

# Type of Impact:

## Acute and Chronic Toxicity

- **Acute Toxicity:**

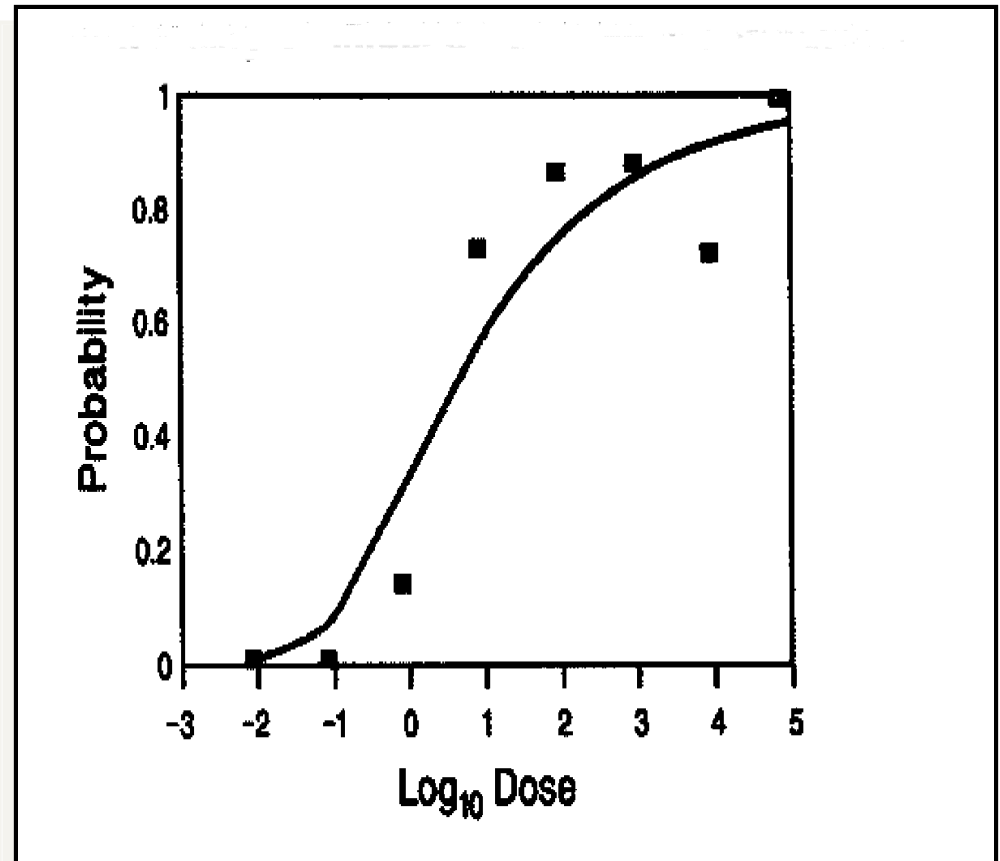
- Adverse effect seen soon after one-time exposure to a chemical
- Can be vomiting, diarrhea, irregular heartbeat, unconsciousness
- Can be caused by overdosing of drugs, farm worker exposed to pesticide, sniffing glue or gasoline etc.

- **Chronic Toxicity**

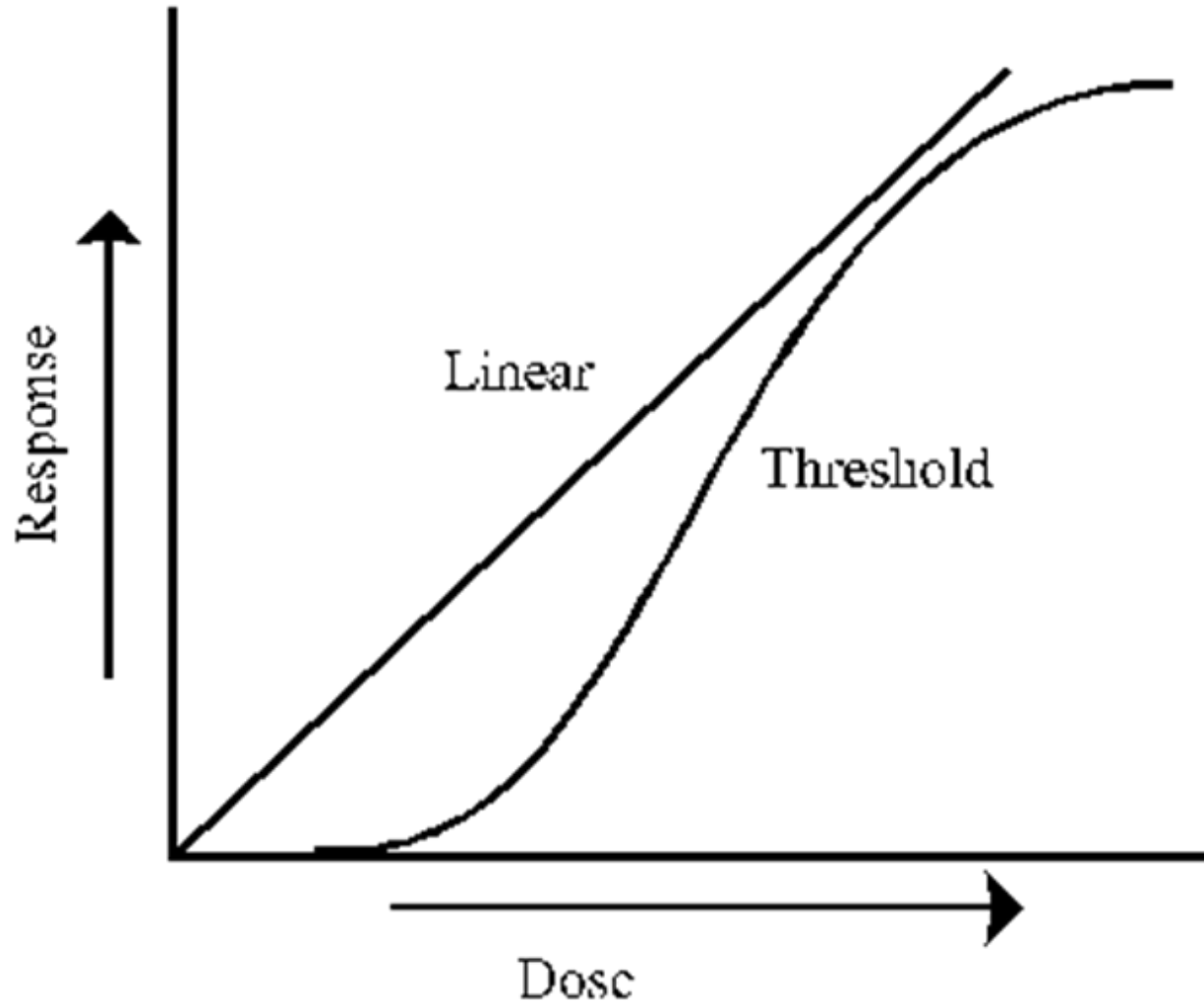
- Results from long-term exposure to lower doses of a chemical
- Long term can be few weeks to tens of years
- Examples: Lung cancer from cigarette smoke, cancer, leukemia from long term exposure to Benzene
- Substance that does not cause acute effect can cause chronic effect and vice versa.
- A one-time exposure to mercury vs long term exposure

# Dose-Response Data and Probability of Infection for Human Rotavirus

Dose	# Dosed	# Infected
90,000	3	3
9,000	7	5
900	8	7
90	7	6
9	7	1
0.9	7	0
0.09	5	0



# Dose-Response and Acceptable Risk





# Comparing Acute Toxicity of chemicals

Toxicity	LD <sub>50</sub> (mg/kg body weight)	Examples
Slightly toxic	500-5000	Aspirin, vitamin, salt
Moderately toxic	50-500	Caffeine, nicotine
Highly toxic	1-50	Sodium cyanide, Vitamin D
Supertoxic	< 0.01	Atropine, nerve poisons
Biotoxins	<<0.01	Botulinum ricin

LD50: Dose which kills 50% of the animals exposed to it

# Risk estimation

## Carcinogenic risks

- Linear Model-Any level of exposure pose a cancer risk
- Carcinogenic risk = (Slope factor) X (Life time average daily dose (LADD))
- USEPA acceptable cancer risk =  $10^{-6}$  (One person getting an additional cancer over a period of 70 years)

## Non carcinogenic Risk

- Non Linear Model
- Health Index = Average daily dose/reference daily dose
- $HI > 1$  in indicate non carcinogenic risk to the exposed population
- $HQ = \sum HI$

# Carcinogenic Risk Characterization

- Expressed as probability that a given exposure will result in cancer
- Calculated for exposure over a 70 year lifetime
- Arsenic: every 2  $\mu\text{g}/\text{l}$  of arsenic in drinking water increases risk by 1 in 100,000
- Tetrachloroethylene: every 2.4  $\mu\text{g}/\text{l}$  of Tetrachloroethylene in drinking water increases risk by 1 in 1000000
- Risk  $< 1$  in million is considered safe ( $1 \times 10^{-6}$ )