

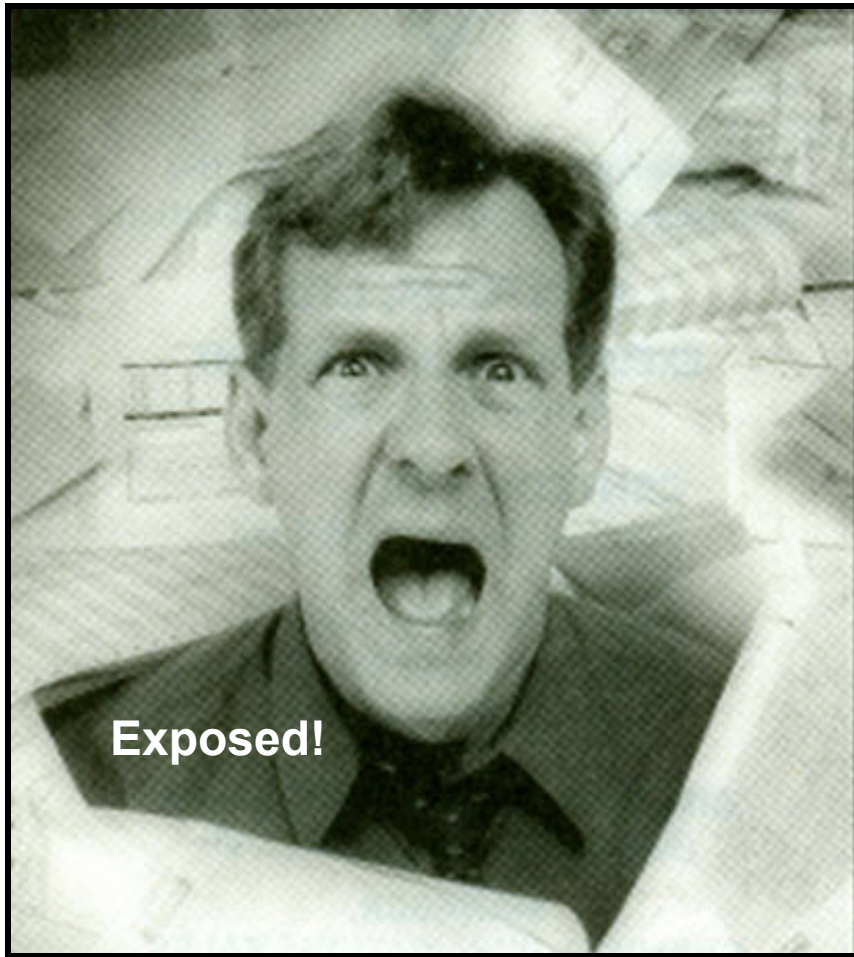
Discovery, development, and regulation of pesticides

Bob Krieger, Ph.D.
Department of Entomology
U C Riverside

**"It's not what we don't know that hurts us,"
said Will Rogers.**

"It's what we know that ain't so."

When chemicals are used as pesticides, some environmental residues and human exposures at some level will occur.



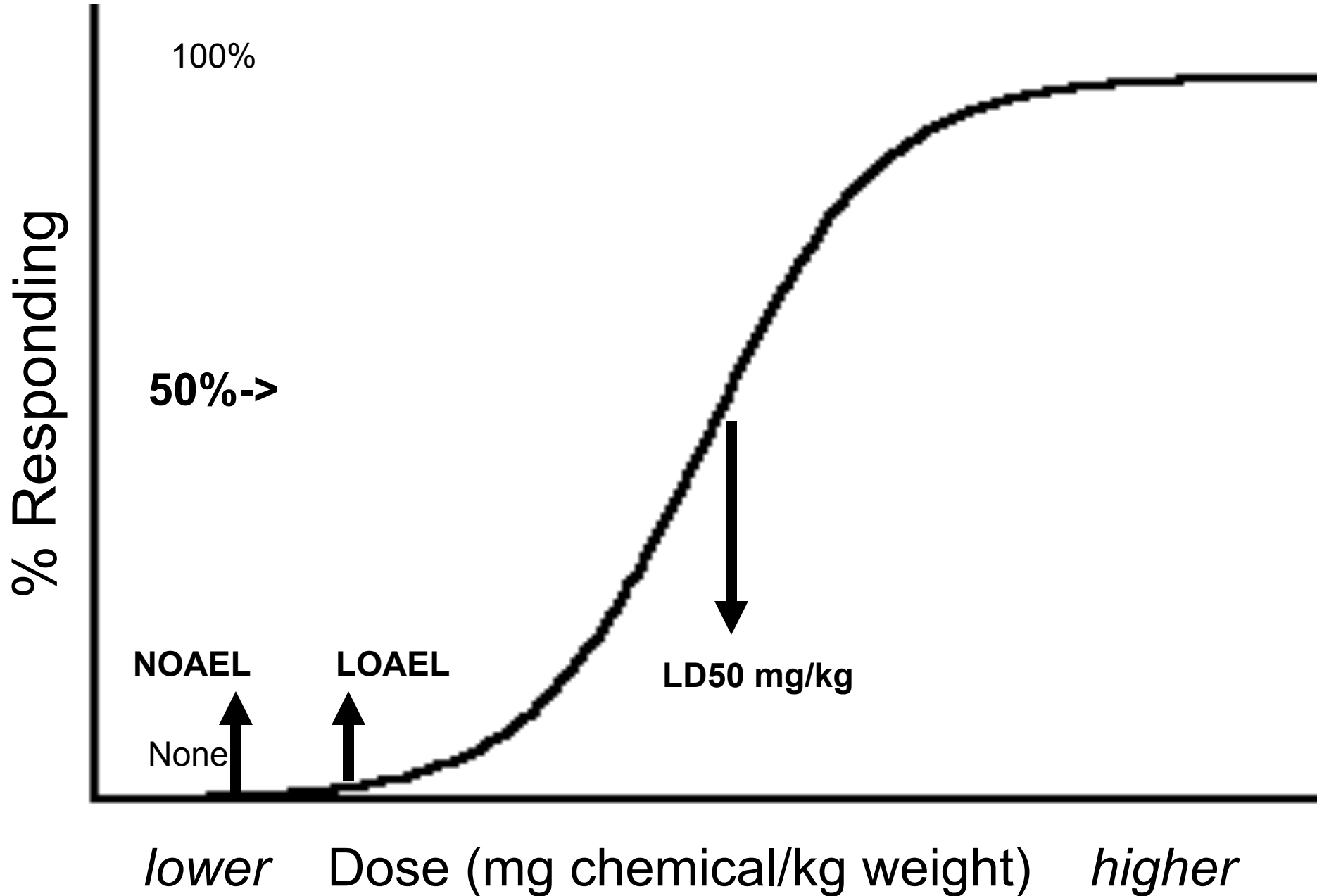
- Exposure is contact with the potential for uptake.
- **Exposure is not a disease.**
- **How much is too much?**
- **How little is OK?**

Environmental residues in water and drift will receive increased attention in 2010.

Administrator Lisa Jackson, USEPA: “I will ensure EPA's efforts to address the environmental crises of today are rooted in three fundamental values: science-based policies and programs, adherence to the rule of law, and overwhelming transparency.”



“Dose-Response Curve”



A photograph of a white mouse on a wooden surface. The mouse is facing left. Overlaid on the image are three text labels: 'Lethal Dose 50' in brown, 'Effective Dose 50' in brown, and 'Low Adverse Effect Level' in yellow. In the bottom right corner, there is a label 'No Adverse Effect Level' in green. The background is a plain, light-colored wall.

Lethal Dose 50

Effective Dose 50

Low Adverse
Effect Level

No Adverse
Effect Level

Measurable levels of pesticides in air, water, and food are almost always below amounts that could be harmful under normal conditions.

- *Air pollution*
- *Water contamination*
- *Food residue*

- Micrograms/liter or
10 liters of air/work day
- 2 liters of water
- 2-5 oz produce/day

Dosage: micrograms/kg
bw



POPs demonstrate the power of analytical chemistry and the naivete of policy-makers and the public.

The issue is an opportunity for enlightenment!

Health Conservative Pesticide Regulation: *“How little is OK?”*

Exposure		Toxic Substance	Reference Dose
Effective Dose	No Effect Dose		Allowable Amount For 70 kg Rat
Cup of coffee	Cup of DeCaf	Caffeine	<i>60 drps DeCaf</i>
Couple of beers	No alcohol beers	Ethanol	<i>70 drps “No Alcohol”</i>
Fries (Lenape var)	Fast food fries	Solanine	<i>1 / 2 fry</i>

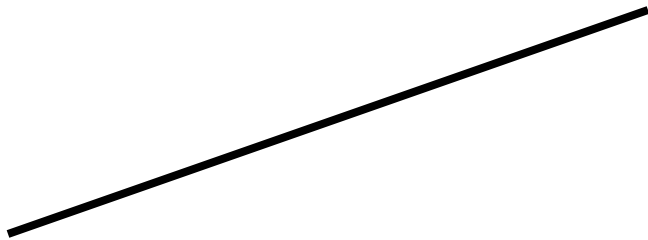
The margin-of-safety (MOS: harmful dose/usual dose) for alcoholic *beverages*, carbon monoxide *combustion byproduct*, secobarbital *sleep aid*, aspirin *pain reliever*, and acetaminophen *pain reliever* is less than the margin-of-exposure for pesticides based upon the (MOE: No Observed Adverse Effect Level dose/usual exposure).

$$\frac{\text{NOAEL (mg/kg)}}{\text{Usual exposure (mg/kg)}}$$

Chemical	Usual Dose	Harmful Dose	Margin of Safety
Alcohol Ethanol Blood Level	0.05%	0.1%	2
Carbon Monoxide % Carboxy Hemoglobin	<10%	20-30%	>2
Secobarbital (sleep aid) Blood Levels	0.1 mg/ dL	0.7 mg/dL	7
Aspirin	0.65 gm 2 tablets	9.75 gm 30 tablets	15
Acetaminophen Tylenol (over 200 products)	500 mg tablet	7000 mg 14 tablets	14

Margin-of-Exposure

NOAEL



Exposure

(Absorbed Daily Dosage)

The pattern of pesticide use is the most important factor responsible for safe and effective chemical use in pest management.

- Discovery and development
- Premarket testing
- Specific label uses
- Directions for use
- Judgment and actions of applicator



Unintentional Injuries On-the-Job

Injury Division	Workers x 10 ³	Deaths 2007	Deaths per 10 ⁵ Workers
Agriculture	2,045	552	26.3
Mining	730	178	24.4
Construction	11,416	1,140	10.0
Manufacturing	16,204	358	2.2
All industries	138,988	4,500	3.2 (2003)
	147,203	4,689	3.2

US National Safety Council, 2009

Fatal Exposures, 2008

Substance	Fatal Pesticide Exposures
Paraquat	1
Organophosphate	4
Carbamate	2
Glyphosate	6
Pyrethroid	1
Rodenticide	1
Copper Sulfate	1
Strychnine	1
TOTAL	17
TOTAL LISTED	1315

Evaluation of 2007 California Illness Investigations (DPR WHS)

Relationship	Agricultural	Non-Agricultural	Relation to Agriculture Unknown or Not Applicable	Total
Definite	10	79	0	89
Probable	195	381	0	576
Possible	113	204	0	317
Pesticide-Associated Subtotal	318	664	0	982
Unlikely	23	75	5	103
Indirect	0	3	0	3
Asymptomatic	71	6	0	77
Unrelated	0	0	154	154
Not Applicable	12	132	16	160
Overall Total	424	880	175	1479

Reported Human Exposures, AAPCC

Year	Millions of Cases
1985	0.9
1990	1.6
1995	2.0
2000	2.2
2005	2.4
2008	2.5

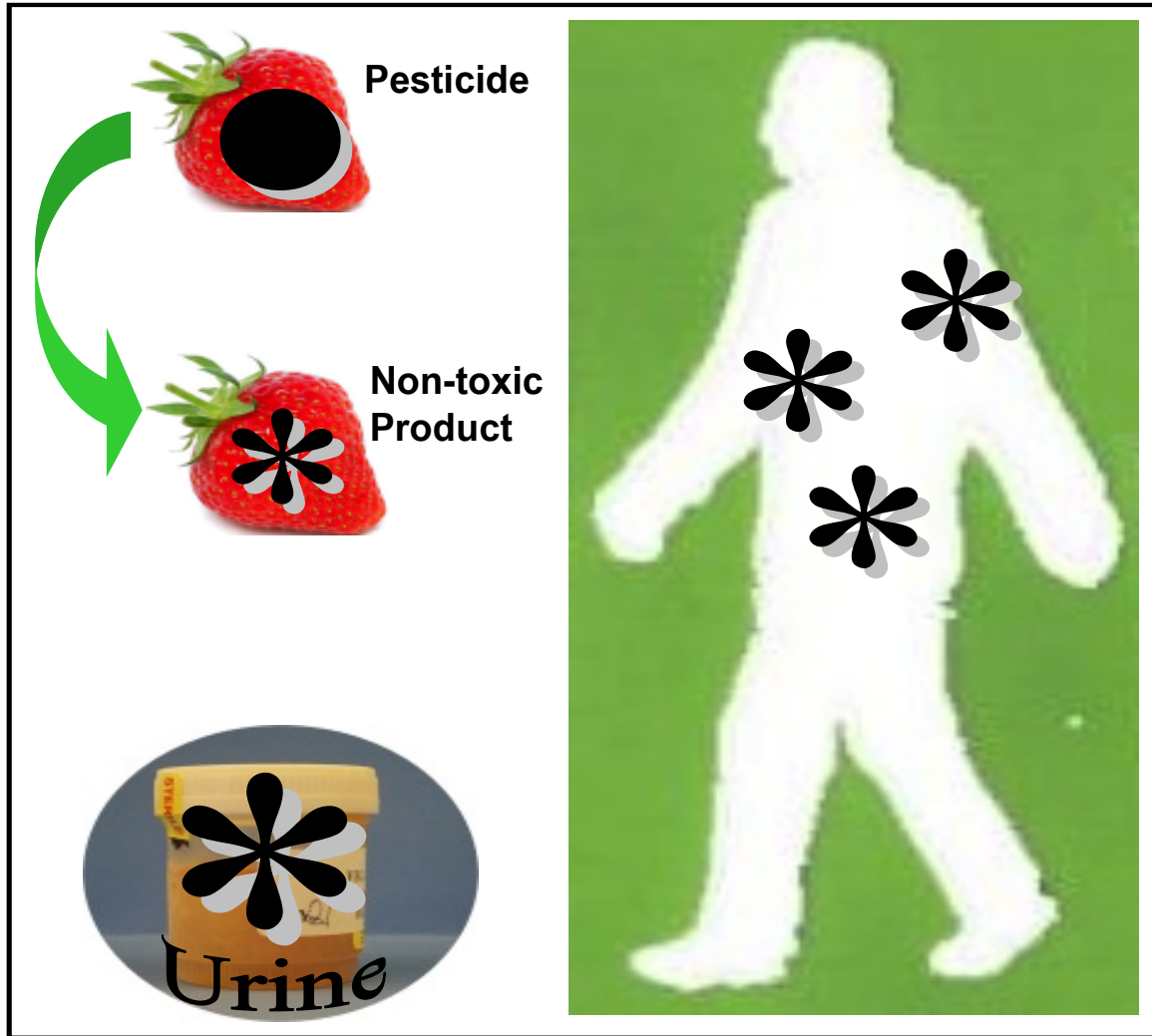
US population-1980: 230; 1990: 250; 2000: 280 million

Biomonitoring Impact

“The emotional dimension of chemical body burden data poses a major communications and stewardship challenge to industry.”

William K. Rawson, Lawyer
Washington, D. C.

**Green Risk Reduction!
Non-Toxic Products of Pesticides
Are Made by Both Plants and People**



When the pesticides are gone, the non-toxic products mean *no consumer pesticide exposure!*



21st Century Chemical Biomarkers, U.S.A.

Ever-present signs of life in blood and urine of the living

Demonstrating safe pest management...

- Everything goes someplace.
- Exposure is inevitable at some level.
- Even zero isn't none!
- Exposure is not an effect.
- *How little is OK?* Usual amounts.
- *What is usual?* Read and Heed the label.