

Pesticide Risk in Perspective

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Toxicology

Scientific study of adverse effects of chemicals

- **Effects** are determined by dose
- Principle made by a physician, alchemist, philosopher: Paracelsus, 1450
- *Dose determines a poison,*
so there must be a safe level of everything!

We live in a chemical world!

More than 31,000,000 known

- Origin

Natural and Synthetic

- Class

Organic and Inorganic

- Use

Process •• ***Commercial Products*** •• Pollutants

Foods • Drugs • Cosmetics • Pesticides

The properties of everything are chemical.

Dose determines a poison!

Paracelsus, 15th century

But, most importantly

Dosing does it!

***Pesticide Safety is
about use!***

The Pesticide Product Label

The label helps you
get maximum benefit
with minimum risk.

Safe use instructions

Signal word

Signal Word

Danger

Warning

Caution

USEPA: California DPR

Toxicity Testing for Safe Use

- Lethal oral dosage
- Lethal skin dosage
- Lethal inhalation dosage

- Eye irritation
- Skin irritation
- Sensitization (*allergy*)

Product Signal Words

Signal word	Acute Oral LD50 (mg/kg bw)
CAUTION <i>slightly toxic</i>	500-5000
WARNING <i>moderately toxic</i>	50-500
DANGER <i>highly toxic</i>	0-50

If pesticides are safe, why the
SIGNAL WORDS on the label?

- Handlers: mix/load/apply
- Day to day exposure during work
- Special protective measures
 - Gloves
 - Face shields or goggles
 - Aprons
 - Coveralls
 - Boots



RESPIRATOR PROTECTION

<u>SPHERES IN YOUR AIR</u>	<u>DIAMETER</u>	<u>RADIUS</u>
• BIG ONES (HAIR)	100 MICRONS	50 mu
• SPRAY	10, 30, 50	5, 15, 25 mu
• RESPIRABLE	LESS THAN 10	5 mu
• REGULATORY FOCUS	2.5 mu	1.25 mu

$$\text{Volume} = \frac{4}{3} \text{ radius}^3$$

Spray protection= 125, 3375, 15625

Safety Evaluation: Premarket Testing

Represents how you get exposed on the job

Route

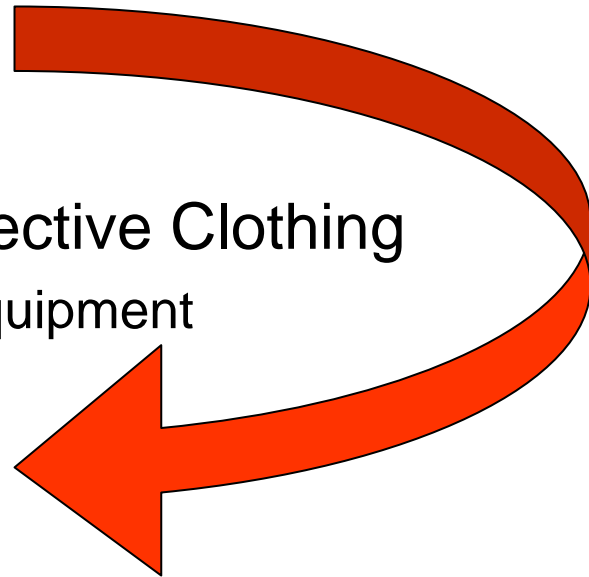
Rate

Response

[Concentration and Time]

Minimizing Pesticide Exposure

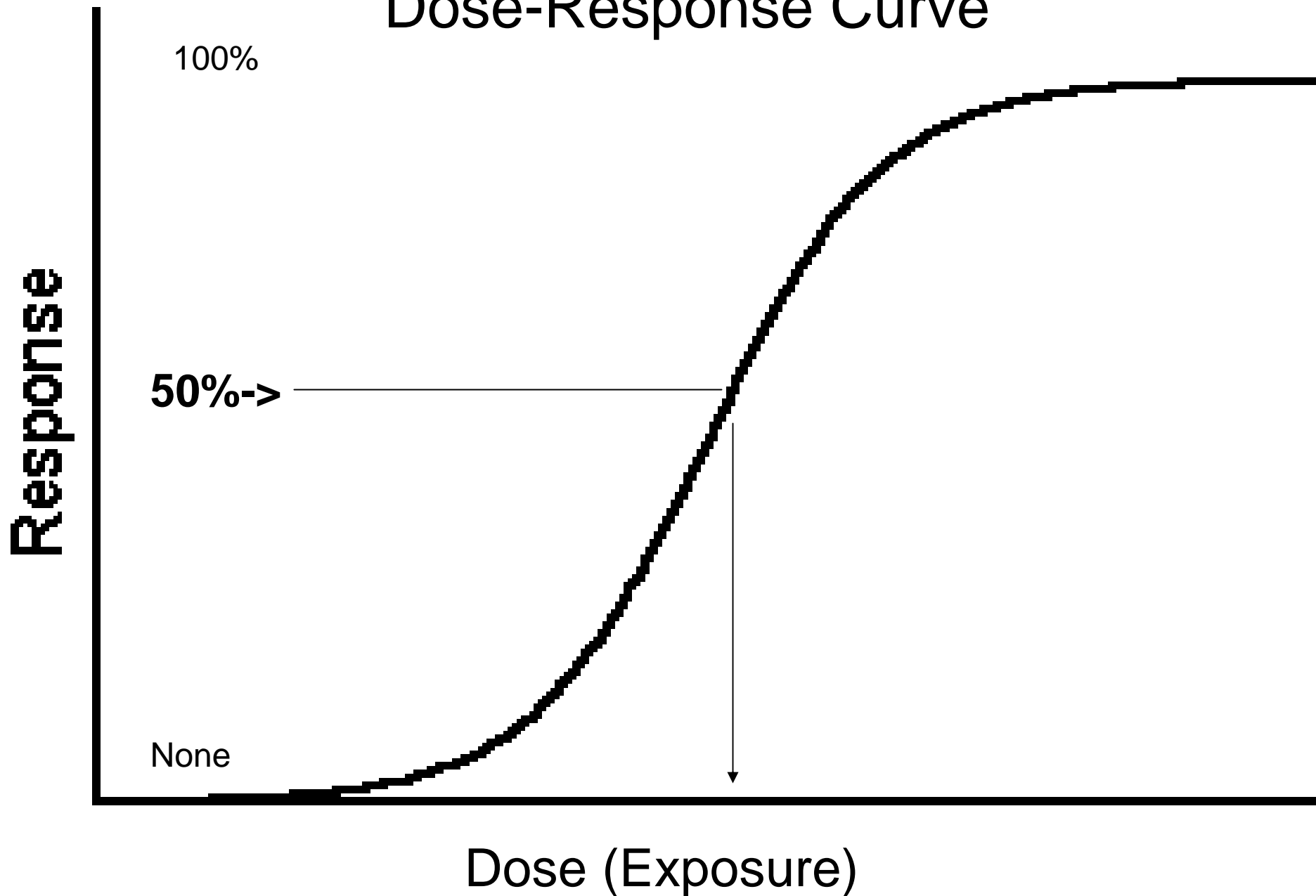
- What you do
 - How you do it
 - Standard Worker Protective Clothing
 - Personal Protective Equipment
 - » Skin
 - » *Personal hygiene*



**Are pesticides the best
studied chemical technology?**

Are pesticides safe when used as directed?

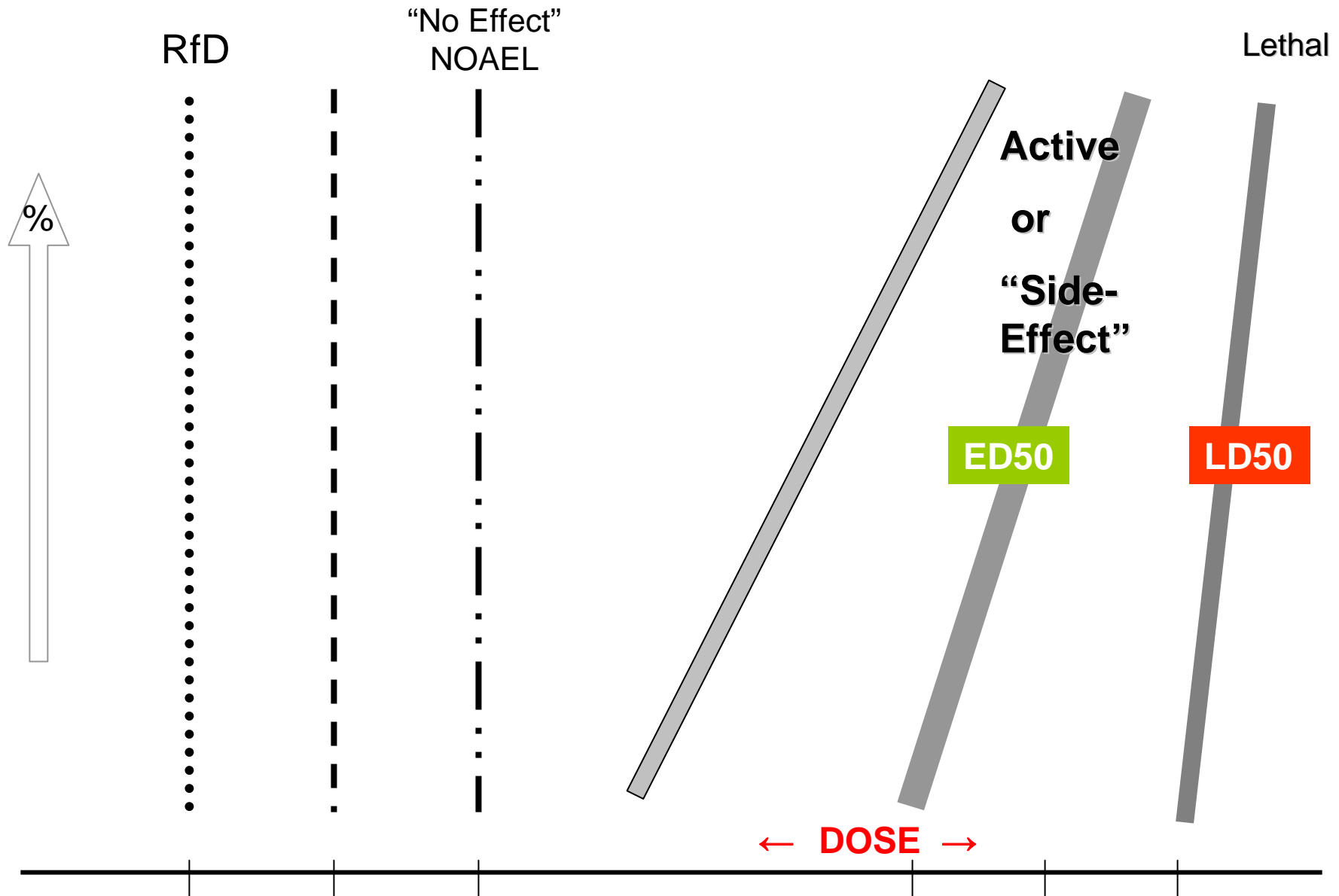
“Dose-Response Curve”



Measures of Response

- LD50
- ED50
- Low Observed Adverse Effect Level
- *No Observed Adverse Effect Level*
 - *Interspecies/10*
 - *Intraspecies/10*
 - *Special issues/up to 10*
- *Reference Dose*

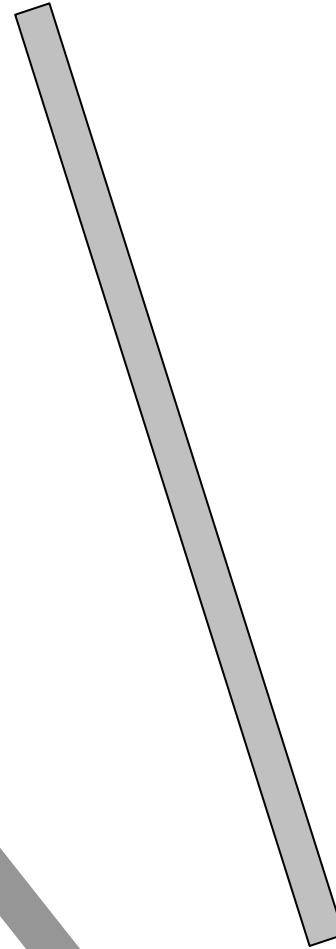
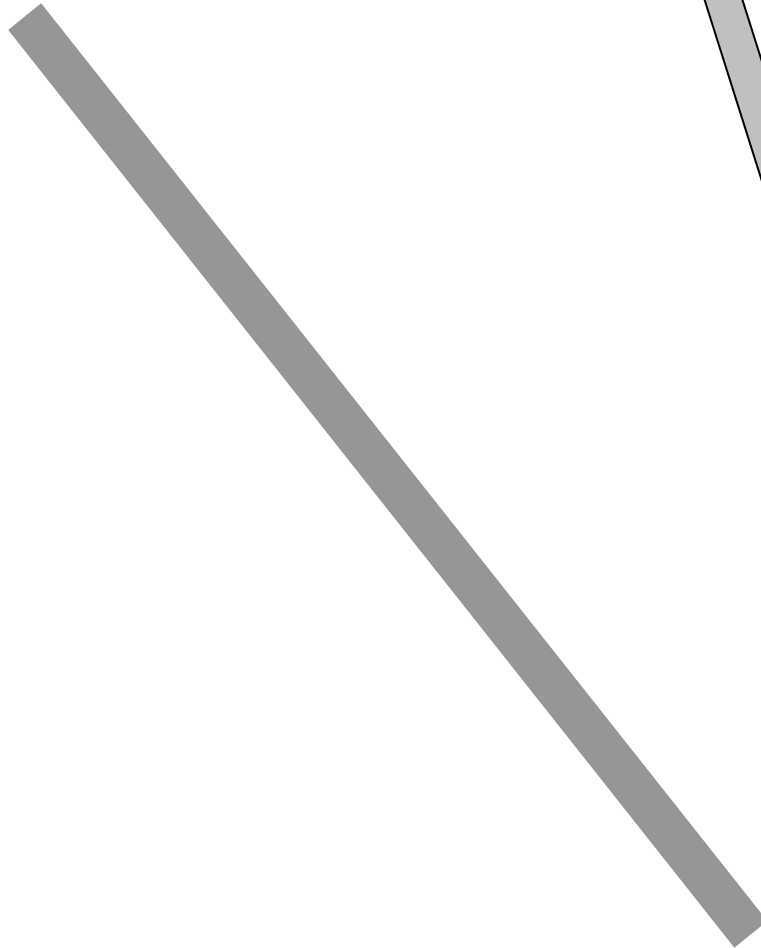
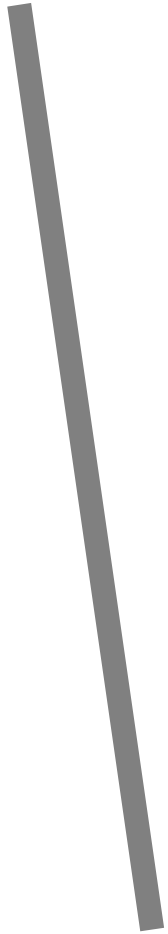
Safety Evaluation: Exposure-Response Relationships



What about everyday exposures and safety evaluation?

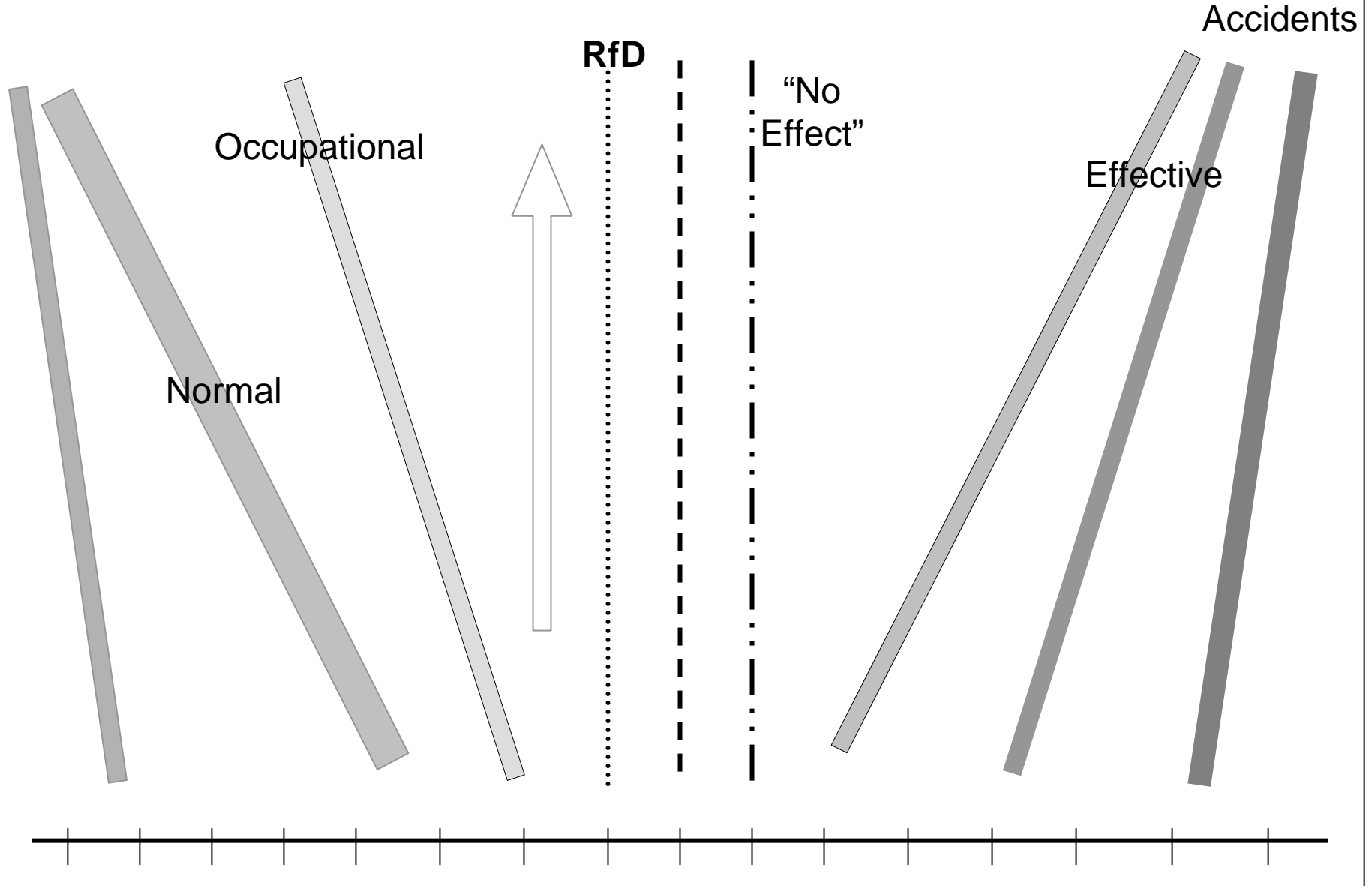
Normal

Occupational



← DOSE →

Yes, Exposure goes with use!



Dental Fluorides

- All products toxic (oral) 4-8.4 mg/kg
- Low observed adverse effect level 1 mg/kg
LOAEL
- No observed adverse effect level 0.09
mg/kg *NOAEL*
- Margin of safety (exposure) 0.09/0.002
MOS (MOE) **45**
Diet 0.04 mg/kg; Water 0.05 mg/kg

Toxicology Profile: 2,4-D

- LD50
- LOAEL
- NOAEL
- Death
 - 800-2000 mg/kg-bw
- Response
 - 60 mg/kg kidney
 - 300 mg/kg testes
- No response
 - 15_k mg/kg
 - 100_t mg/kg

2,4-D Reference Dose

- NOAEL 15 mg/kg kidney
- Uncertainty Factors
 - Species: animal to human (0.1) 1.5 mg/kg
 - Person-to-person (0.1) 0.15 mg/kg

$$\text{RfD} = \text{NOAEL} \times 0.1 \times 0.1$$

Toxicology Profile: Glyphosate

- LD50
- LOAEL
- NOAEL
- Death
 - >5000 mg/kg-bw
- Response
 - 3500 mg/kg-d maternal and developmental
- No response
 - 1000 mg/kg-d

Pesticide Margin-of-Exposure (Safety)

NOAEL / Exposure \gg 100

Margin-of-Exposure

RfD



Exposure (ADD)

A red starburst shape with a black outline, centered on a white background. The text "Look at the Record" is written in white, bold, sans-serif font inside the starburst.

**Look at the
Record**

Unintentional Injuries On-the-Job

Injury Division	Workers x 10 ³	Deaths 2003	Deaths per 10 ⁵ Workers
Agriculture	3,340	710	20.9
Mining	539	120	22.3
Construction	9,268	1,060	11.4
Manufacturing	17,708	490	2.8
All industries	138,988	4,500	3.2

US National Safety Council, 2004

Causes of Death, 2004

Cause	Number	Deaths per 10 ⁵ Deaths
All unintentional injuries	101,537	35.6
Motor-vehicle	43,788	15.4
Falls	15,019	5.3
Poisoning	14,078	4.9
Pesticide	7	0.0025
Choking	4,185	1.5
Drowning	3,281	1.2
All other	21,186	7.4

National Safety Council, 2004

Chemical Exposures— you can't live without 'em!

- Chemical exposure is essential
- Exposure can be measured
- Exposure is not a disease

- Dose is the chemical part of risk
- Risk reduction is an ongoing process!

Risk

Chemicals are not associated with risk unless a vulnerable group of people are exposed and produce a harmful effect.

Chemical

Risk

Toxicity