

Applied Chemistry[^] *and* for Golf Course Superintendent *Toxicology*



Blankinship & Associates, Inc.
Applied Agricultural & Environmental
Scientists & Engineers
Davis, CA

s-block

1 New Designation
IA Original Designation

s-block
18
VIIIA

1	1 H 1.0094	2 He 4.00260											Non-Metals						
	s-block												p-block						
			d-block																
			Transition Metals																
2	3 Li 6.941	4 Be 9.0122											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.179	
3	11 Na 22.990	12 Mg 24.305	3 IIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIII	11 IB	12 IIB	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948	
4	19 K 39.098	20 Ca 40.08	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80	
5	37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.91	54 Xe 131.29	
6	55 Cs 132.91	56 Ba 137.33	57 to 71	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)	
7	87 Fr (223)	88 Ra 226.03	89 to 103	104 Unq (261)	105 Unp (262)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Une (266)	110 Uun (267)	(Mass Numbers in Parentheses are from the most stable of common isotopes.)							Phases Solid Liquid Gas	
			Metals																

Rare Earth

Elements

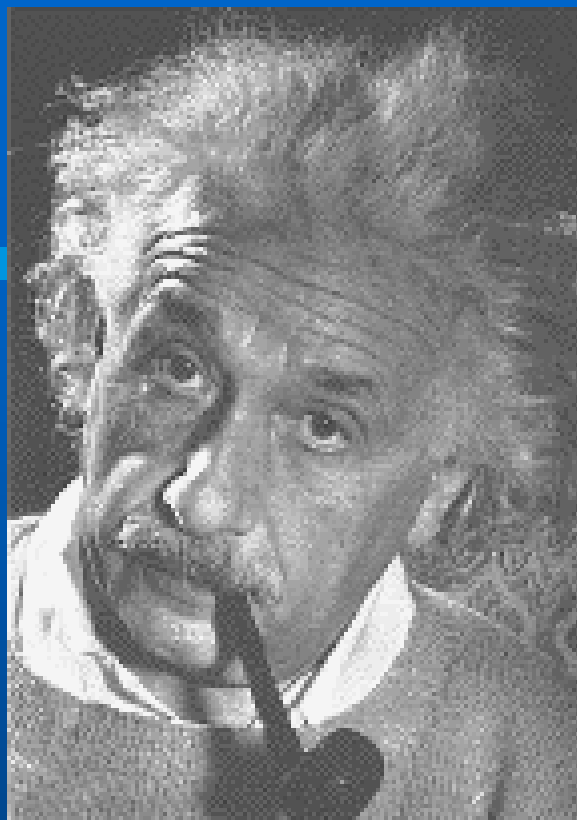
d-block

f-block

Lanthanide Series

Actinide Series

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)



**You don't
have to be
Einstein
to put
chemistry
and
toxicology
to work
for you**

Objective

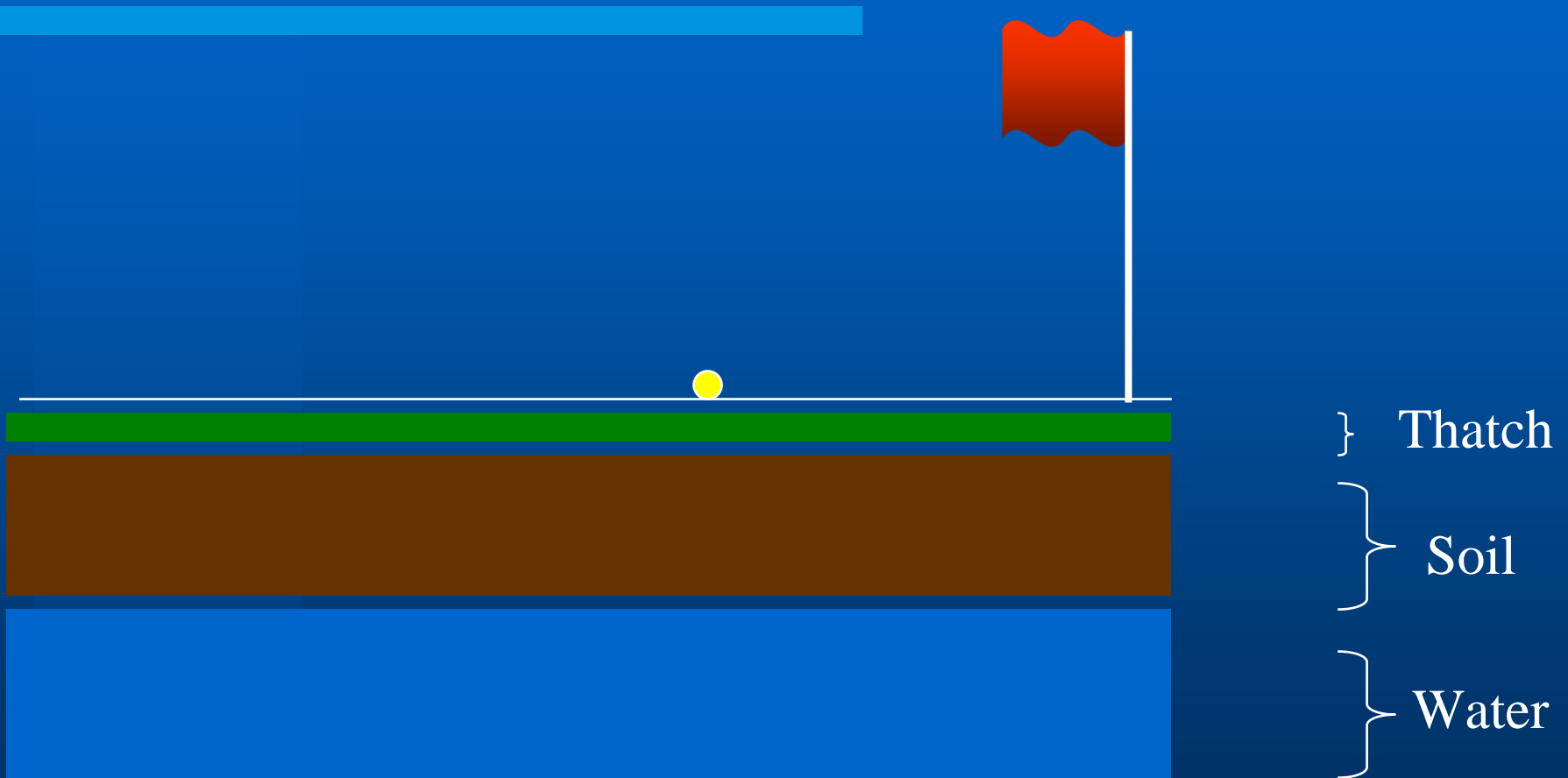
Cover two key concepts:

- **Environmental Chemistry**
- **Toxicology** as they relate to:
 - ✓ The Behavior of Pesticides
 - ✓ Water Quality
 - ✓ Thinking Ahead to Protect Natural Resources

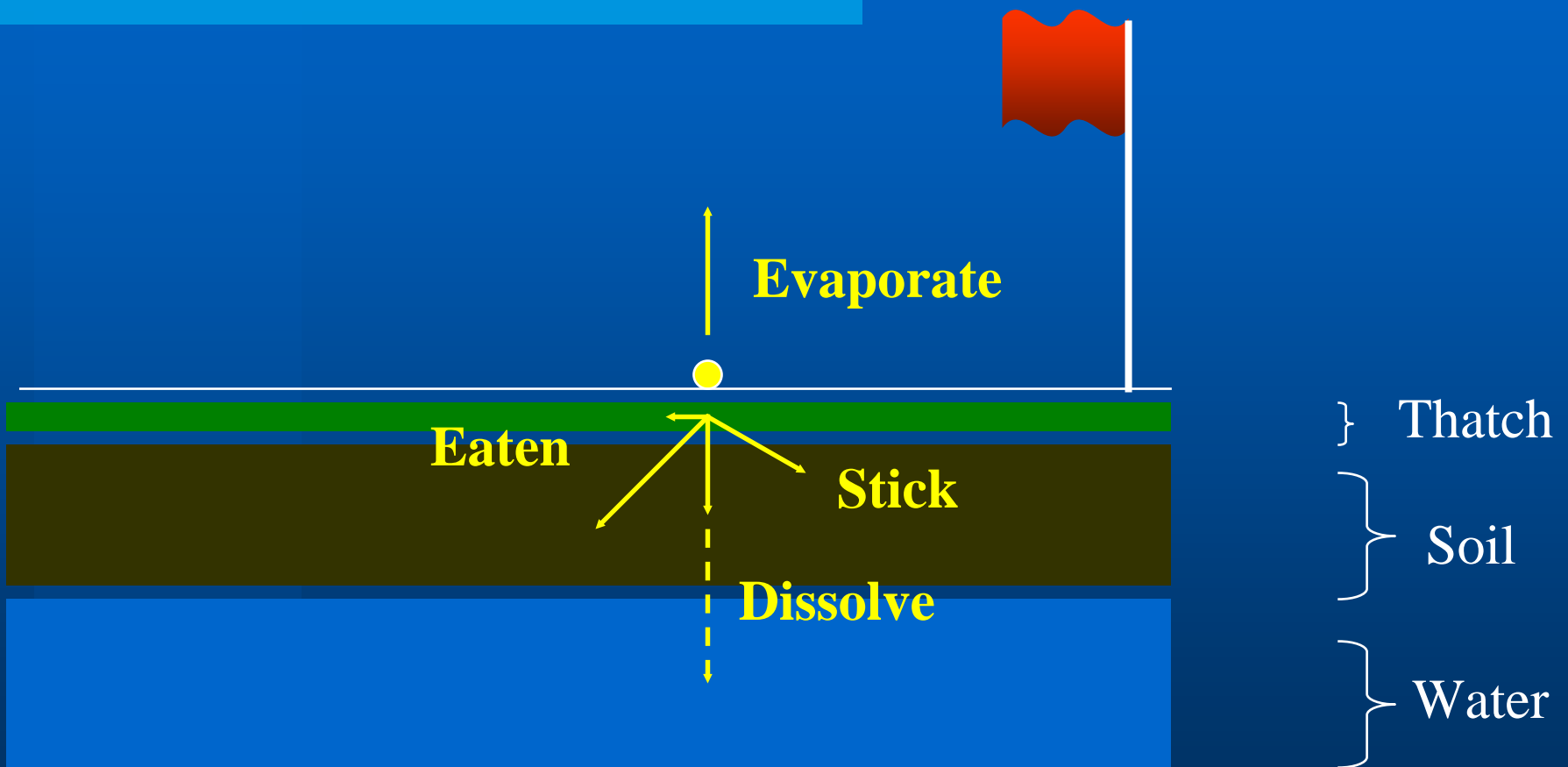
Environmental Chemistry

- What Is It ?
- How Do You Use It ?

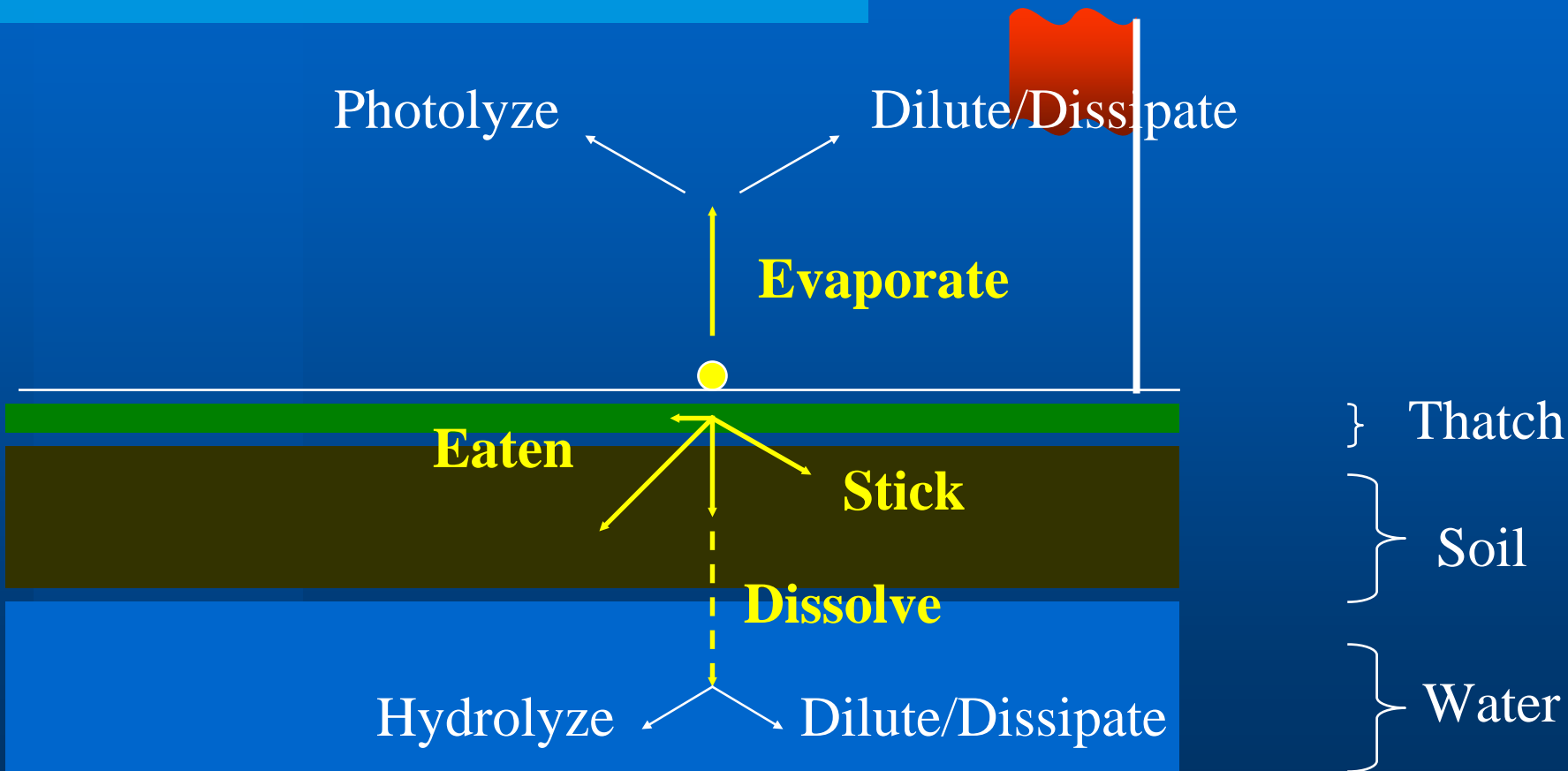
Environmental Chemistry: What Is It?





Environmental Chemistry: What Is It?



Environmental Chemistry: What Is It?



Term	Aka	Measured By
Evaporate	Evaporate/ Volatilize	Vapor Pressure
Eat	Metabolize	 Life
Stick	Adsorb	Adsorption Coefficient
Dissolve	Solubilize	Solubility

Term	Aka	Measured By	What is Good Number?
Evaporate	Evaporate/ Volatilize	Vapor Pressure	Low
Eat	Metabolize	 Life	Low
Stick	Adsorb	Adsorption Coefficient	High
Dissolve	Solubilize	Solubility	Low

Example: A superintendent considers the use of pyrethroids to control cutworms on USGA green adjacent to a pond



Problem: Pyrethroids are highly effective, but highly toxic to fish and invertebrates

Term	What is Good Number ?	Bonide®	Deltagard®
Evaporate	Low	10⁻⁷	10⁻⁸
Eat	Low	12	108
Stick	High	22	850
Dissolve	Low	4,600	2

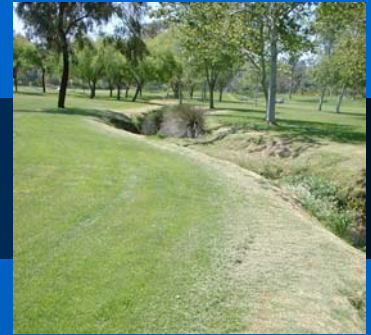
Solution: Make a selection that exploits desirable environmental chemistry traits to:



- **Protect pond water quality**
- **Minimize impacts to tile drain water quality**
- **Use BMPs to Do the Rest**

Term	What is Good Number ?	Bonide®	Deltagard®
Evaporate	Low	10^{-7}	10^{-8}
Eat	Low	12	108
Stick	High	22	850
Dissolve	Low	4,600	2

Use BMPs to Supplement Your Chemistry



- Buffer Strip
- Windfoil
- Light, Infrequent Irrigation
- Bioswales
- Maintain High Organic Content Soil



February 15, 2003

Toxicology: The Great Debate



Natural

vs.



Synthetic

Toxicology Refresher

● LC₅₀

–Lethal Concentration that kills 50% of a test population

–Typically expressed in mg/L

● LD₅₀

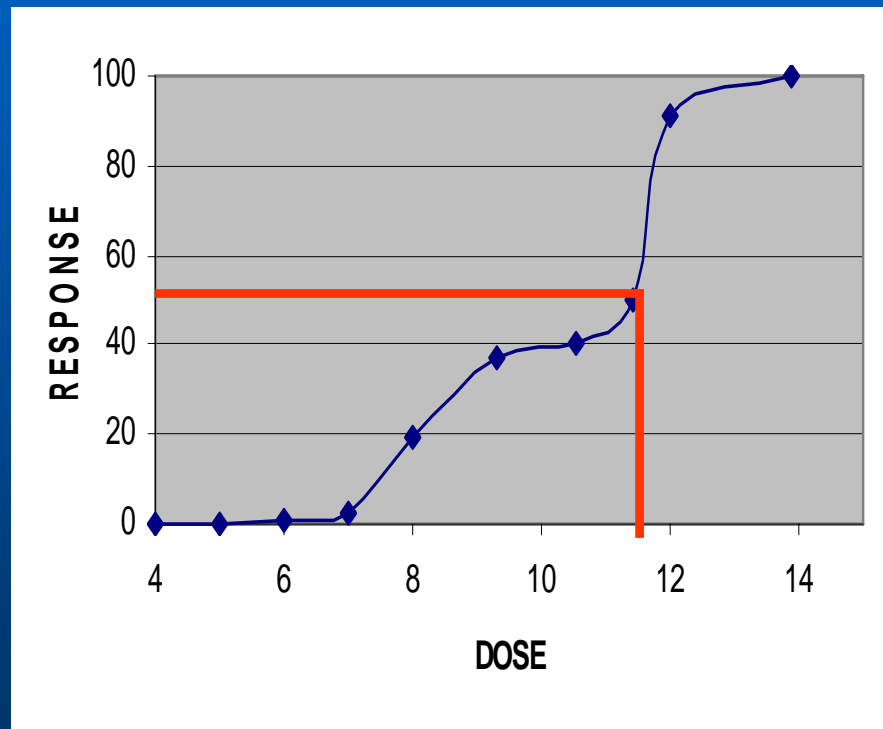
–Lethal Dose that kills 50% of a test population

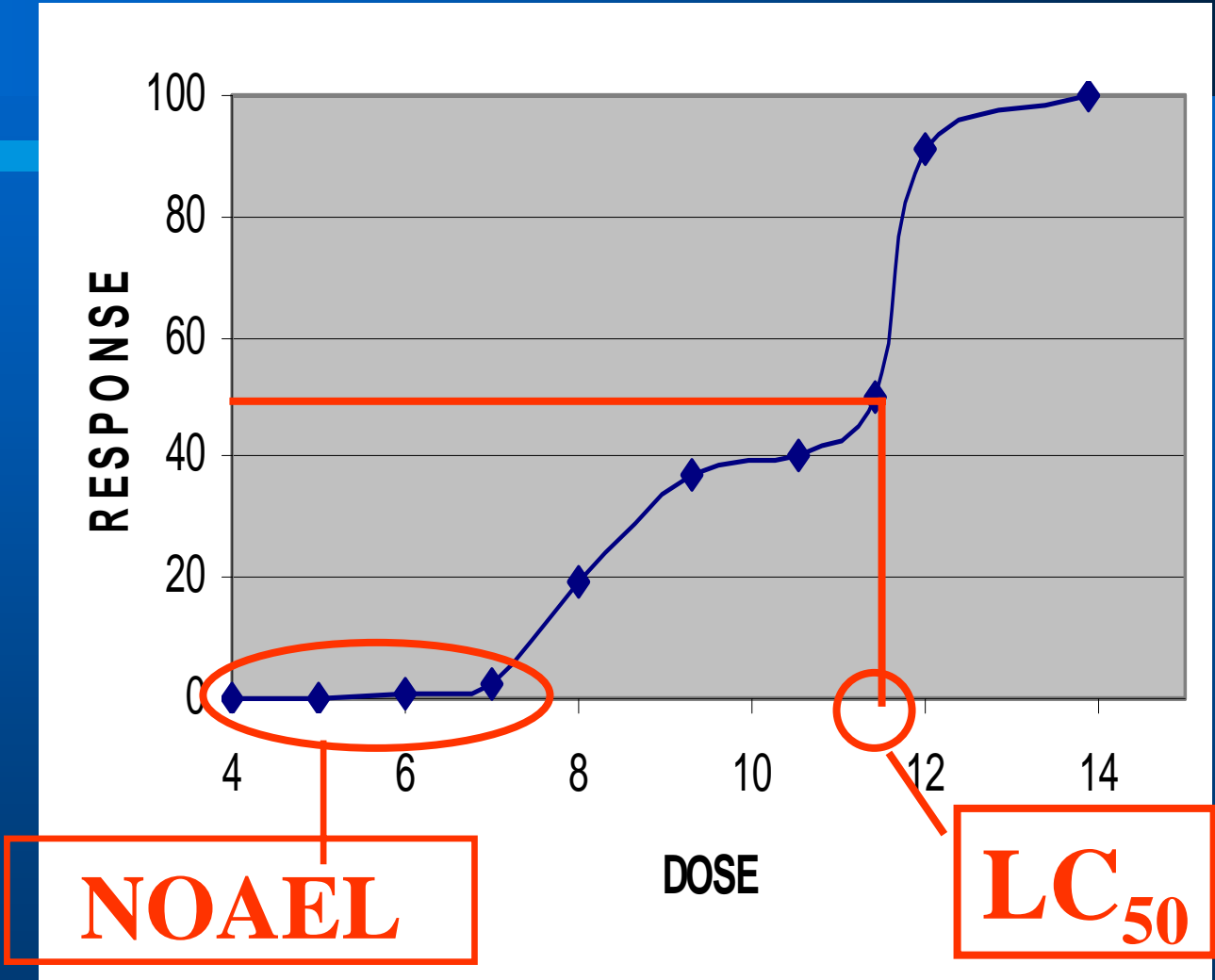
–Typically expressed in mg/Kg of animal body weight

The Dose Makes The Poison

“What is it that is not a poison? All things are poison and nothing is without poison.”

Paracelsus, 1567





Comparative Aquatic Toxicity

Product	Source	LC₅₀ bluegill	LC₅₀ trout	LC₅₀ shrimp
Bonide[®]	Natural (Flowers)	51	24	0.77
Deltagard[®] (Deltamethrin)	Synthetic (Lab)	1	1	0.002

Remember:

- Generally speaking, when comparing 2 chemicals, the lower LC₅₀, the more toxic
- Not all pesticides have similar effects on all wildlife
- Risk = Exposure x Toxicity

Remember:

- Risk = Exposure x Toxicity
- Risk \neq Toxicity
- In Other Words, Just Because Something is Toxic, It May or May Not Pose a Risk

You Can't Change Toxicity...

...So Manage Exposure

- **Pick Your Chemical Wisely**
- **Be Aware of Sensitive Receptors**
- **Use BMPs**

Conclusions:

- Environmental Chemistry: Deltagard[®]
- Aquatic Toxicology: Bonide[®]

In the End:

Using Both, You Make the Call
and Know Why