

Pesticide in Your Environment

Brian Buckley PhD

Environmental and Occupational
Health Sciences Institute

bbuckley@eohsi.rutgers.edu

Pesticide

Pesticides are defined as “chemical substances used to prevent, destroy, repel or mitigate any pest ranging from insects (i.e., insecticides), rodents (i.e., rodenticides) and weeds (herbicides) to microorganisms (i.e., algicides, fungicides or bactericides)”

Alavanja M. C. (2009). Introduction: pesticides use and exposure extensive worldwide. *Reviews on environmental health*, 24(4), 303–309. <https://doi.org/10.1515/reveh.2009.24.4.303>

History

☞ **Prehistoric:** Sulfur, whale oil, arsenic, nicotine, chrysanthemum, copper

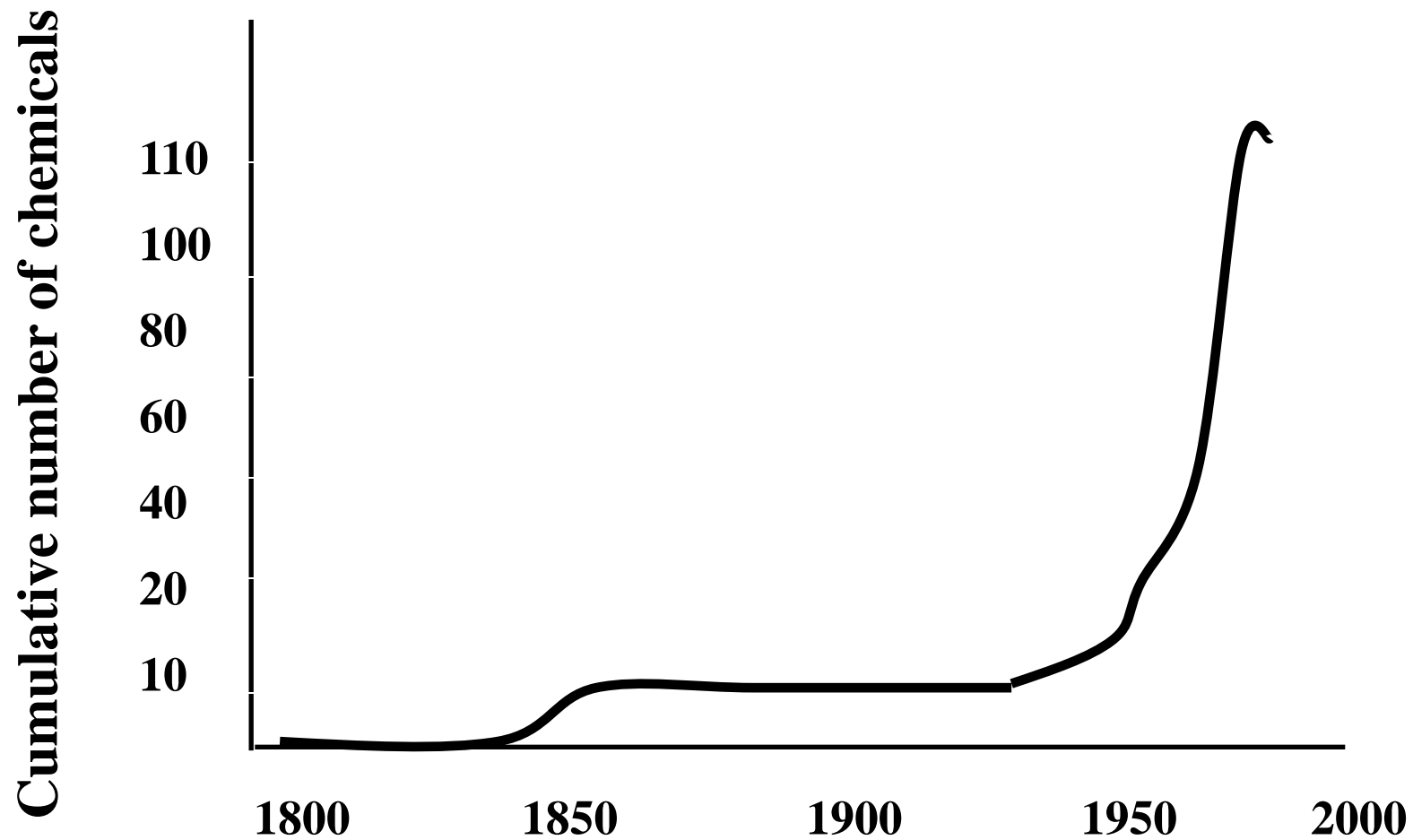
☞ **Early 19th Century:** ethylene bromide, ethylene oxide, carbon disulfide (as fumigants)

☞ **DDT:** Synthesized by Zeidler, 1874; Patented Müller, 1944 (to Geigy)

☞ **Beginning of World War II:** DDT, , dinitrocresol, 2,4-D

☞ **TEPP:** Used as war gas in WW, insecticide in early 1940s, Parathion: Germany 1944

Historic Use of Pesticides

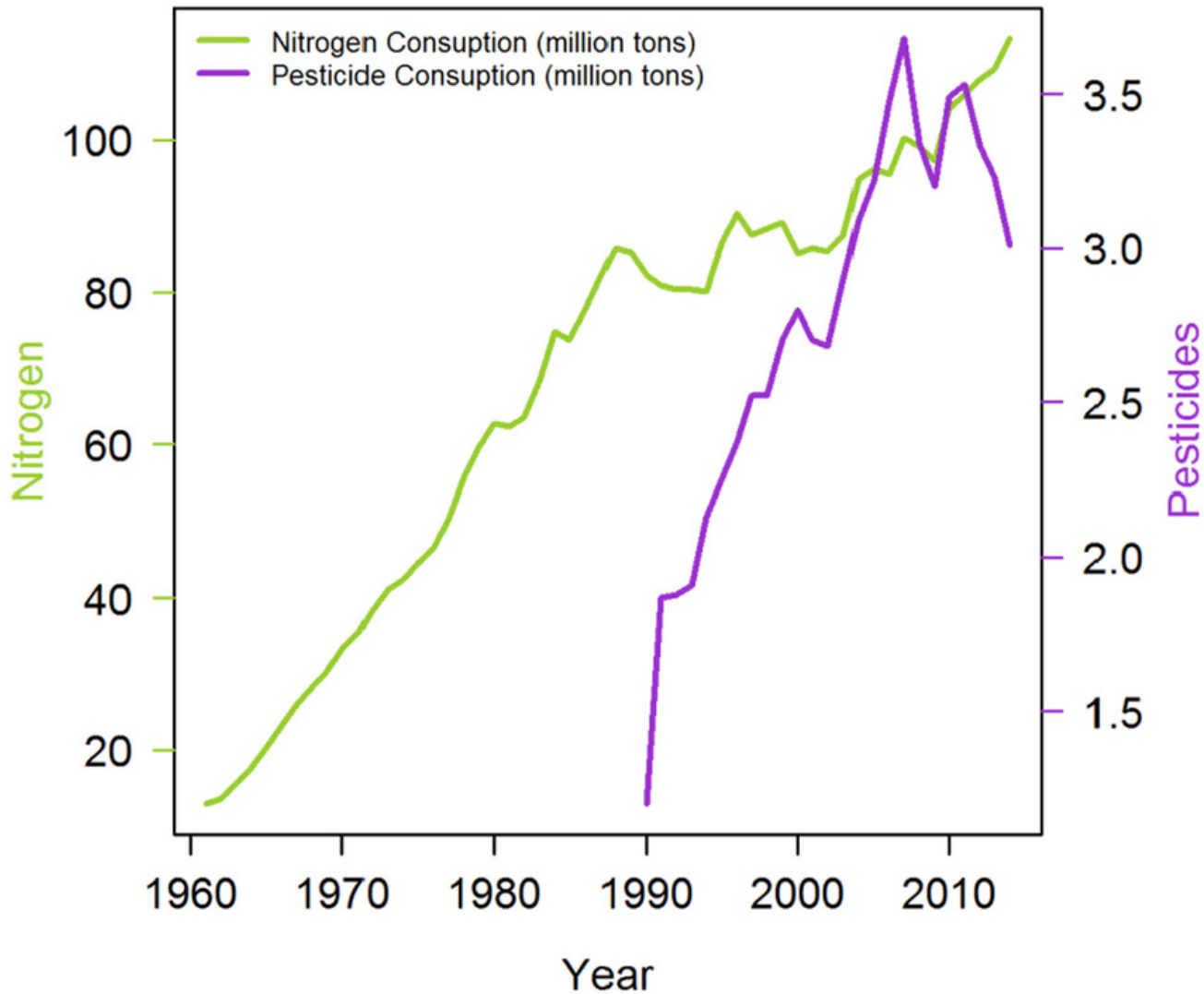


Pesticide Use

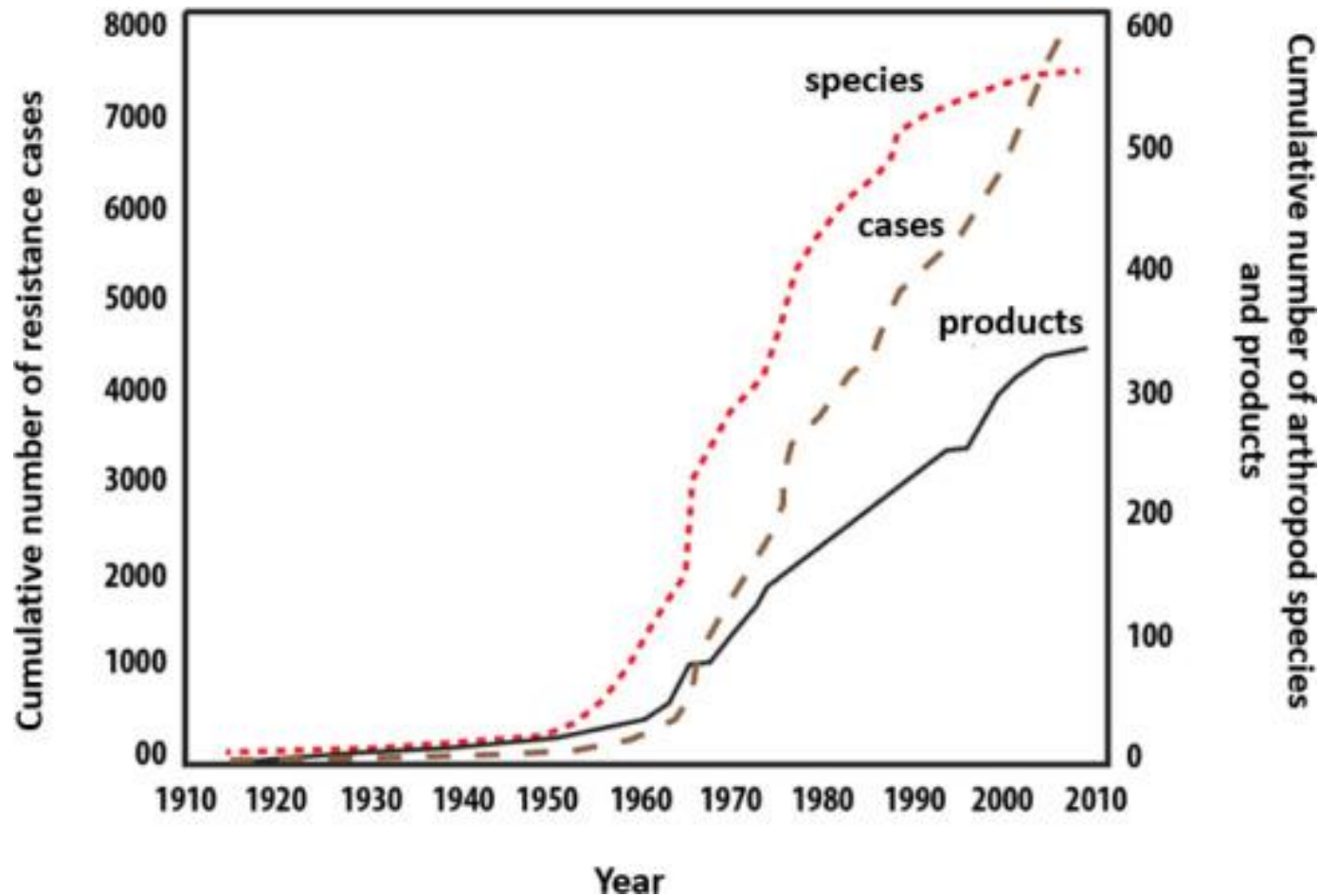
- 5.6 billion pounds chemicals per year
 - 890 active ingredients, 30,000 formulations
 - Uses
 - 75% agricultural
 - 25% home, garden, structural



Increase in use

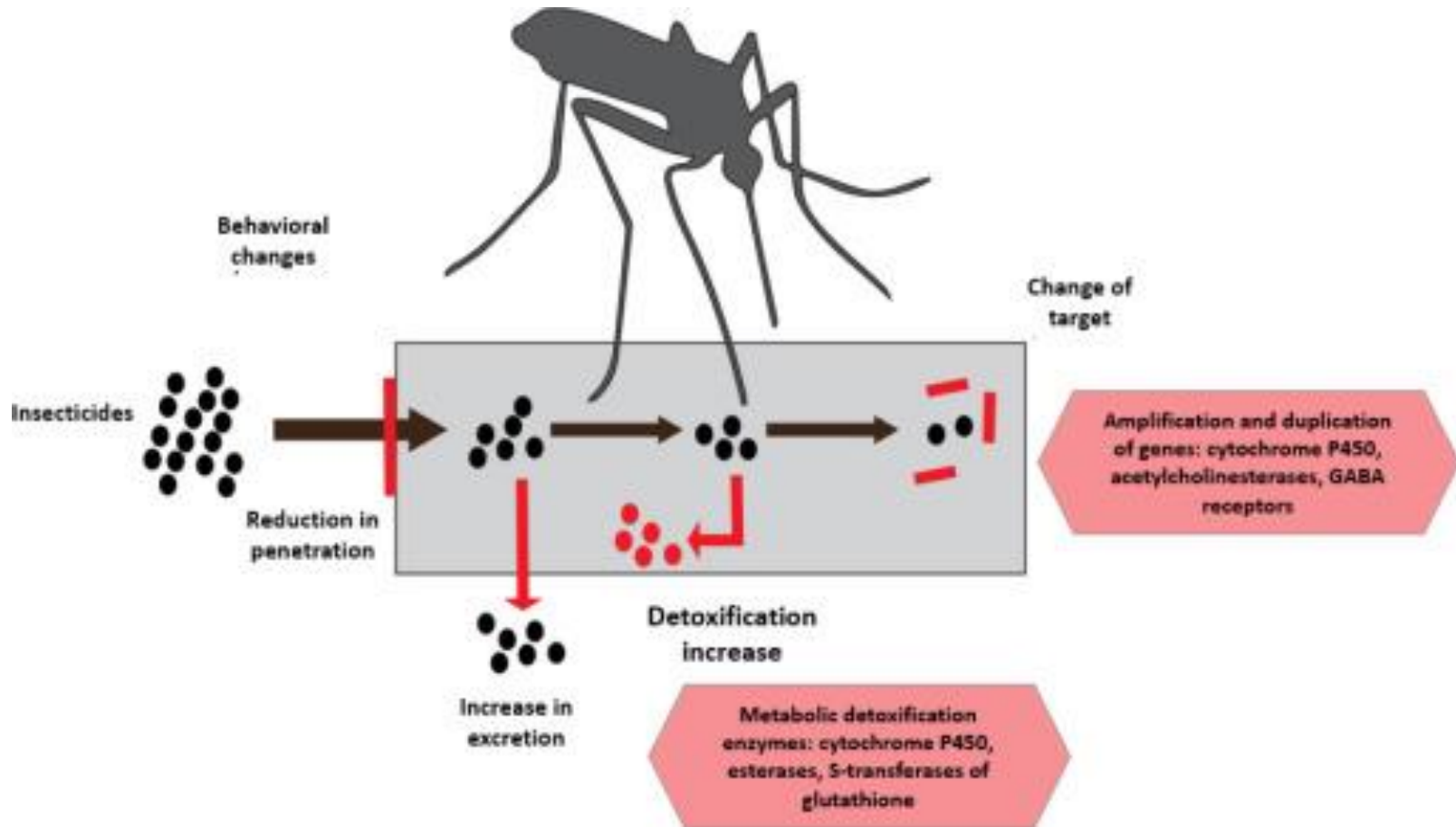


Increased Use



Ascough, J.C., Fathelrahman, E.M. and McMaster, G.S., 2008. Insect pest models and insecticide application. Encyclopedia of Ecology. Academic Press, Oxford, pp.1978-85.

Reasons for increase



Pesticide classes

- herbicides,
- insecticides,
- fungicides,
- rodenticides,
- Pediculicides (lice)
 - FIFRA = Federal Insecticide, Fungicide and Rodenticide Act

Exposure pathways

- Inhalation
- Ingestion
- Dermal absorption
 - % of body exposed
- Injection

Pesticide Exposure: Environmental-Occupational Interface

- Drift
 - Off-target physical movement of pesticide through air
- Take-home
 - Contaminated clothing
 - Pesticide containers brought home

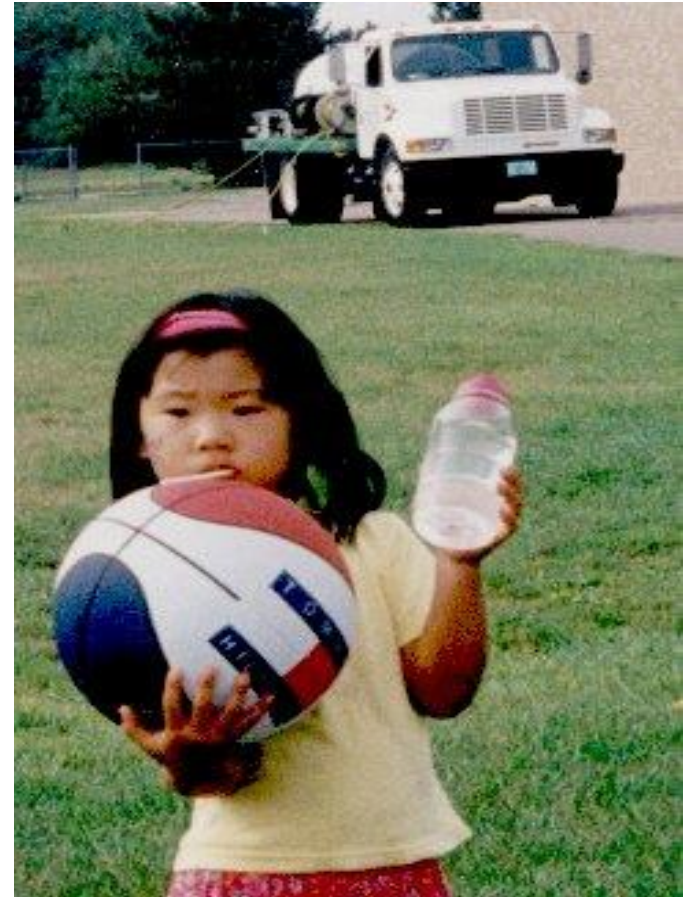


Human Exposure to Pesticides

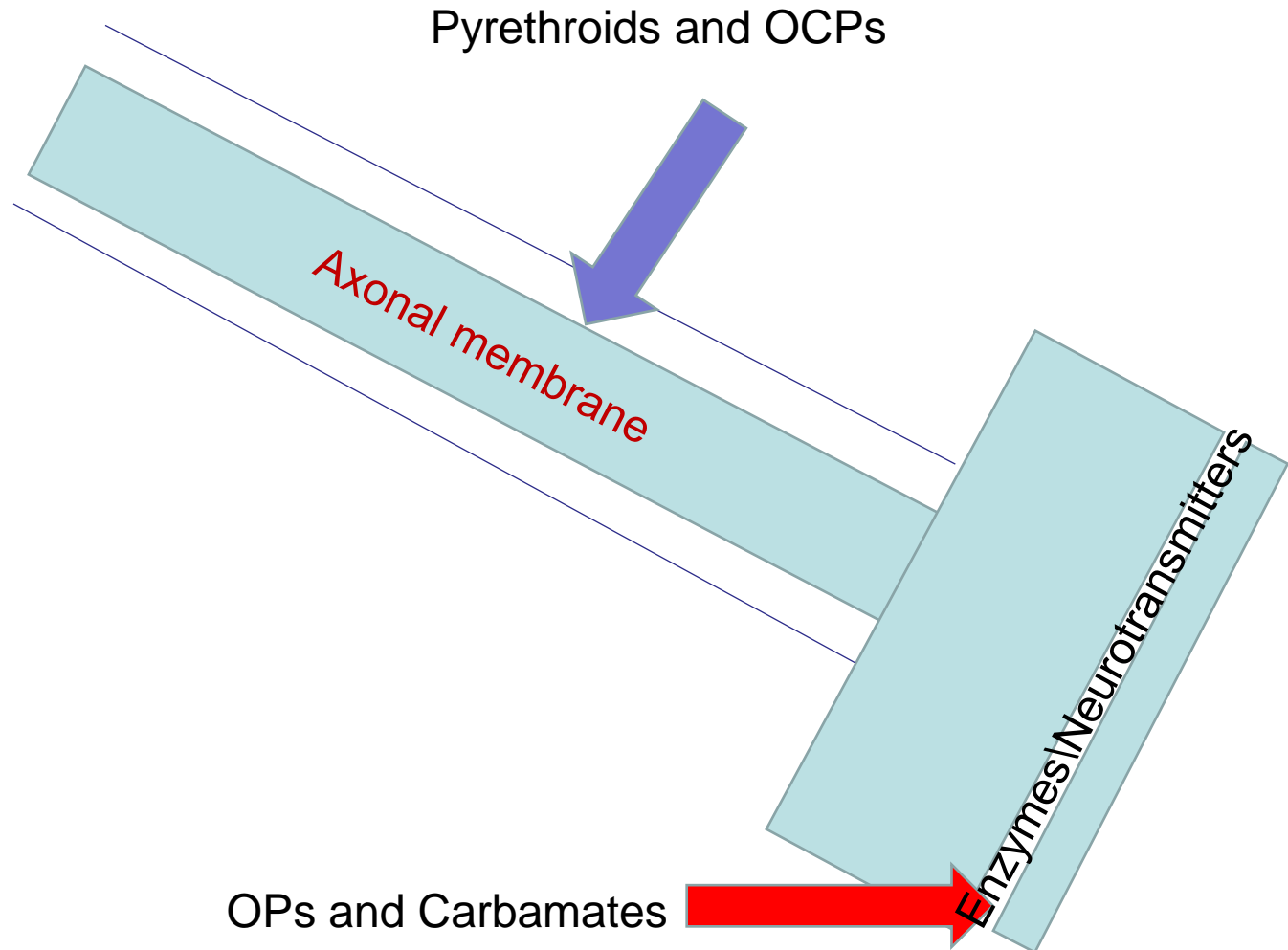
- Second National Report on Human Exposure to Environmental Chemicals
 - <http://www.cdc.gov/exposurereport/>
- Pesticides or metabolites detected in general population, 1999-2000
 - Organophosphates
 - Organochlorines
 - Carbamates
 - Herbicides
 - Pest Repellents & Disinfectants
 - *Today would include Pyrethroids*

Pesticide Exposure: Environmental Settings

- Use in schools
- Lawn, garden use
- Household cleaning
- Home pesticide use
- Residues in food



Sites of action Neuron

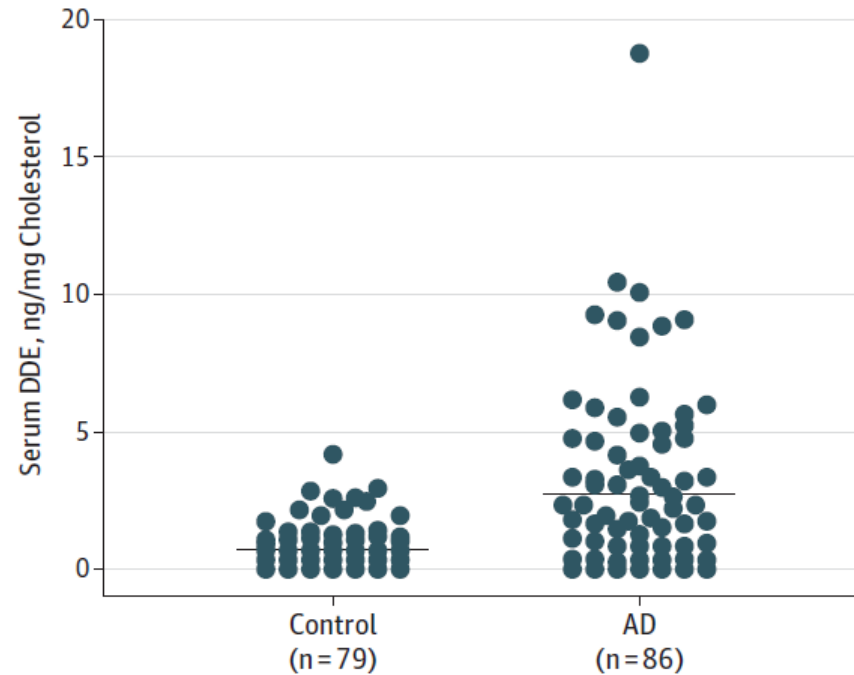


Organochlorine Pesticides (OCs)

OC pesticides are:

- Stable in the environment
- Neurotoxic
- Cheap
- Effective

Figure 1. Serum Levels of Dichlorodiphenyldichloroethylene (DDE)



Serum levels of DDE are elevated in Alzheimer disease (AD). Data were pooled from University of Texas Southwestern Medical Center and Emory University. Levels of DDE are significantly higher in patients with AD (mean [SEM], 2.64 [0.35]) vs control participants (mean [SEM], 0.69 [0.10]; $P < .001$).

Organophosphates OPs



OPs

- **Organophosphate** esters are
 - most toxic of all pesticides to vertebrates
 - unstable or non (less) persistent
 - work by acetylcholinesterase inhibition

Volatiles and Pesticide

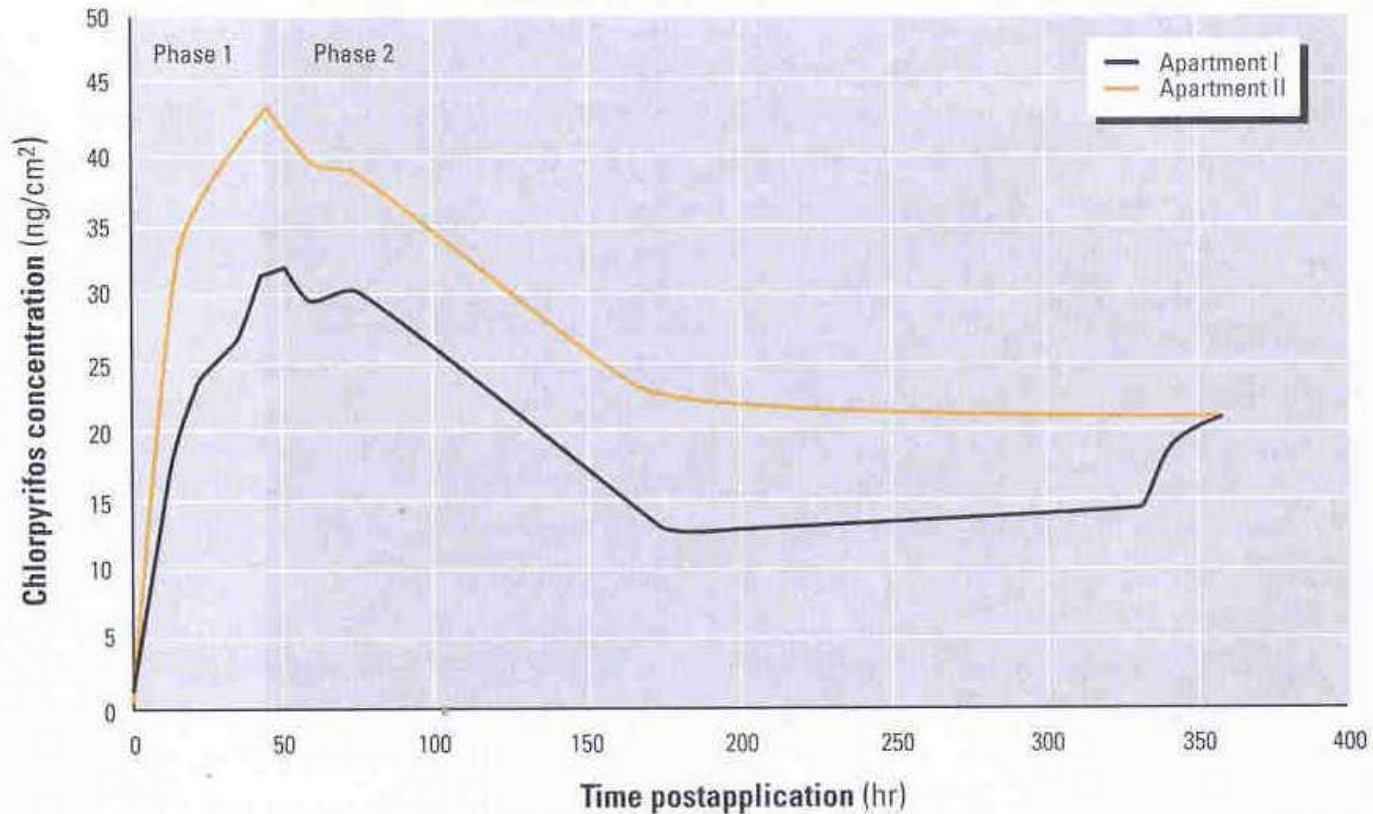


Figure 5. Simulation of surface loading of semivolatile organic compounds—chlorpyrifos deposition and volatilization over a 2-week period. Phase 1 is dominated by deposition, and Phase 2 is dominated by volatilization.

Guess Who?



Chlorpyrifos on Toys

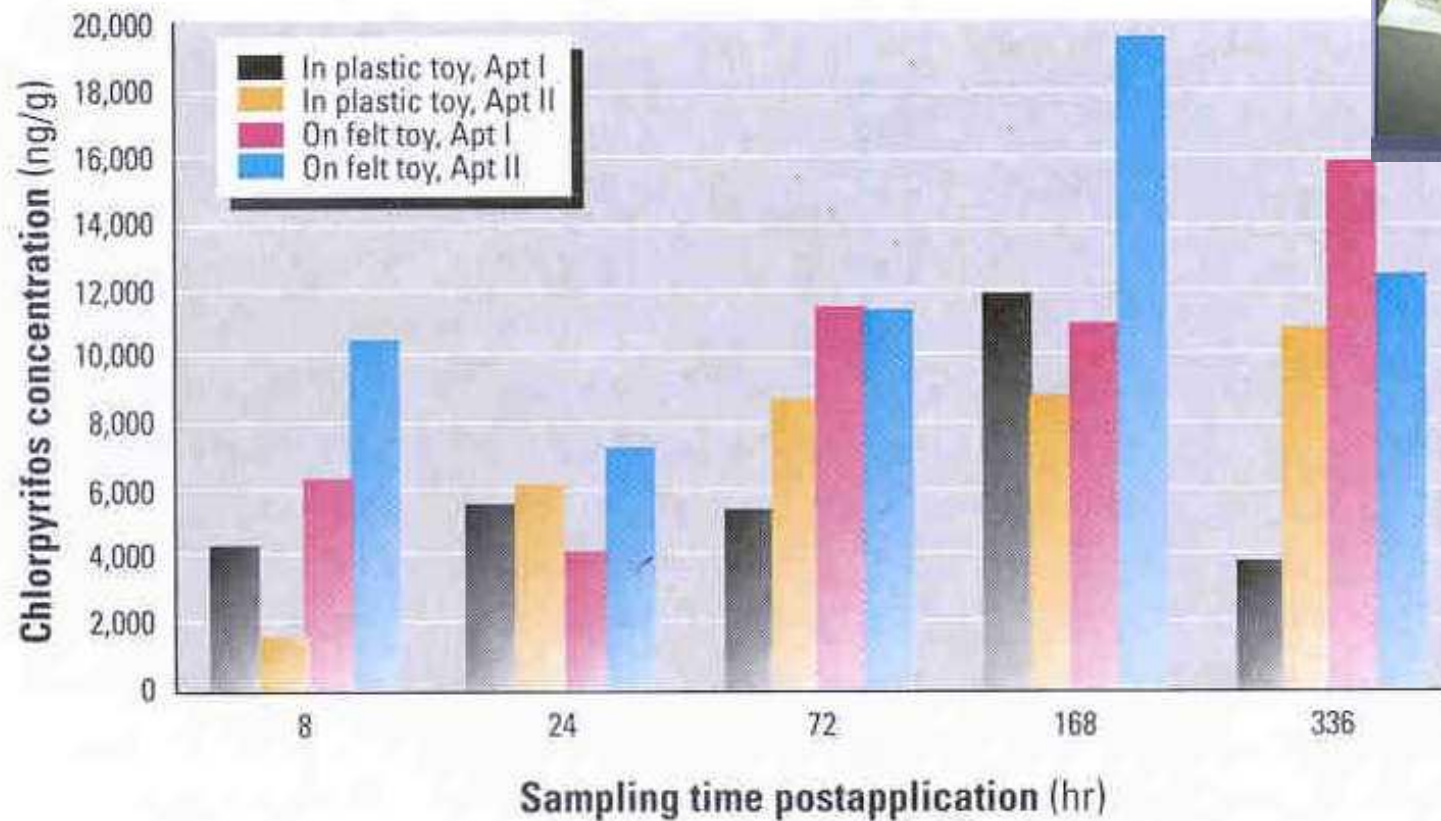


Figure 3. Accumulation of chlorpyrifos residues in plastic and on felt toys in two apartments (Apt I and Apt II).

Move onto EOHSI

Accumulation of Chlorpyrifos on Residential Surfaces and Toys Accessible to Children

Somia Gurunathan,^{1,2} Mark Robson,¹ Natalie Freeman,¹ Brian Buckley,¹ Amit Roy,¹ Roy Meyer,³ John Bukowski,⁴ and Paul J. Liou¹

¹Environmental and Occupational Health Sciences Institute, Rutgers University and the University of Medicine and Dentistry of New Jersey, Robert Wood Johnson Medical School, Piscataway, NJ 08855 USA; ²Joint Ph.D. Program in Exposure Assessment, Department of Environmental Sciences, Rutgers, and The UMDNJ-Robert Wood Johnson Medical School, Piscataway, NJ 08855 USA; ³New Jersey Department of Environmental Protection, Pesticide Control Program, Trenton, NJ 08625 USA; ⁴University of Prince Edward Island, Charlottetown, Canada

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PESTICIDE MEASUREMENT ON TOYS, PLATES AND WALLS, HOW DRY IS DRY?

MARK ROBSON¹, ROY MEYER², PAROMITA HORE¹, SCOTT PETLICK¹, AND BRIAN BUCKLEY¹,

Who is our target population

- It is estimated that full-time homemakers and young children spend up to 90% of their time indoors¹
- Children may be exposed to pesticides via multiple routes and from multiple media

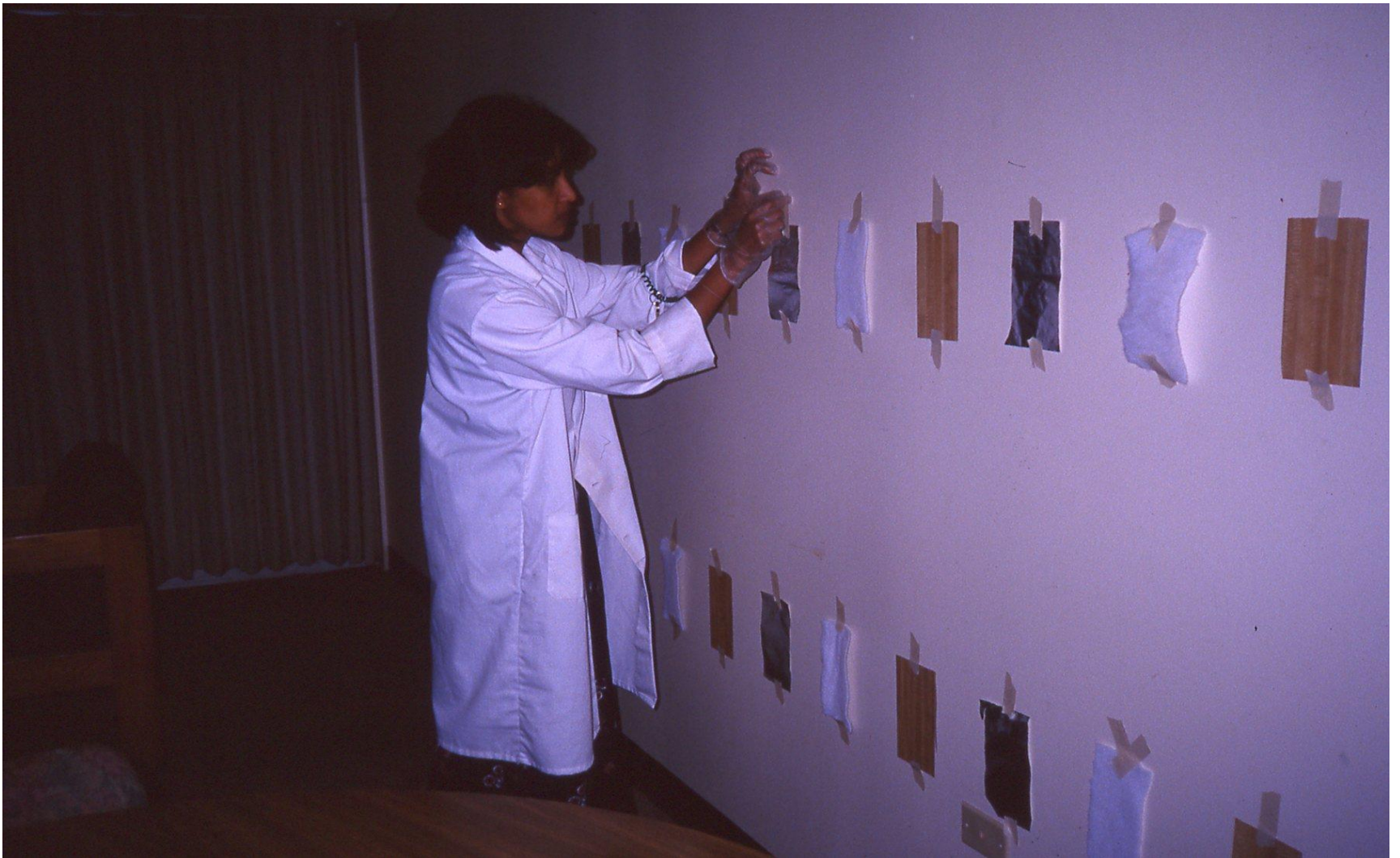


Why especially kids

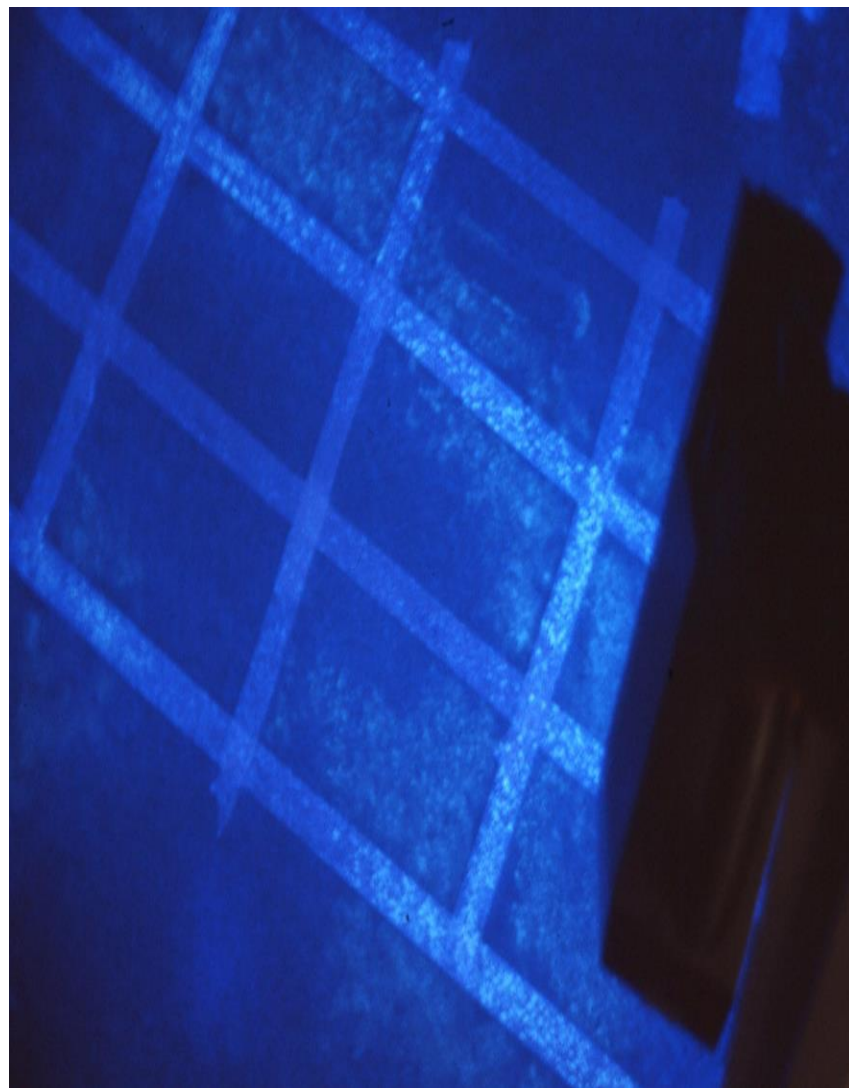
- Young children can be particularly susceptible to pesticides because:
 - Undergoing development (metabolism & excretion of toxicants)
 - Greater dermal absorption due to greater surface area to volume ratio
 - Enhanced hand-to-mouth activities
 - Intimate contact with toys, increasing risk from non-dietary ingestion



Wall application

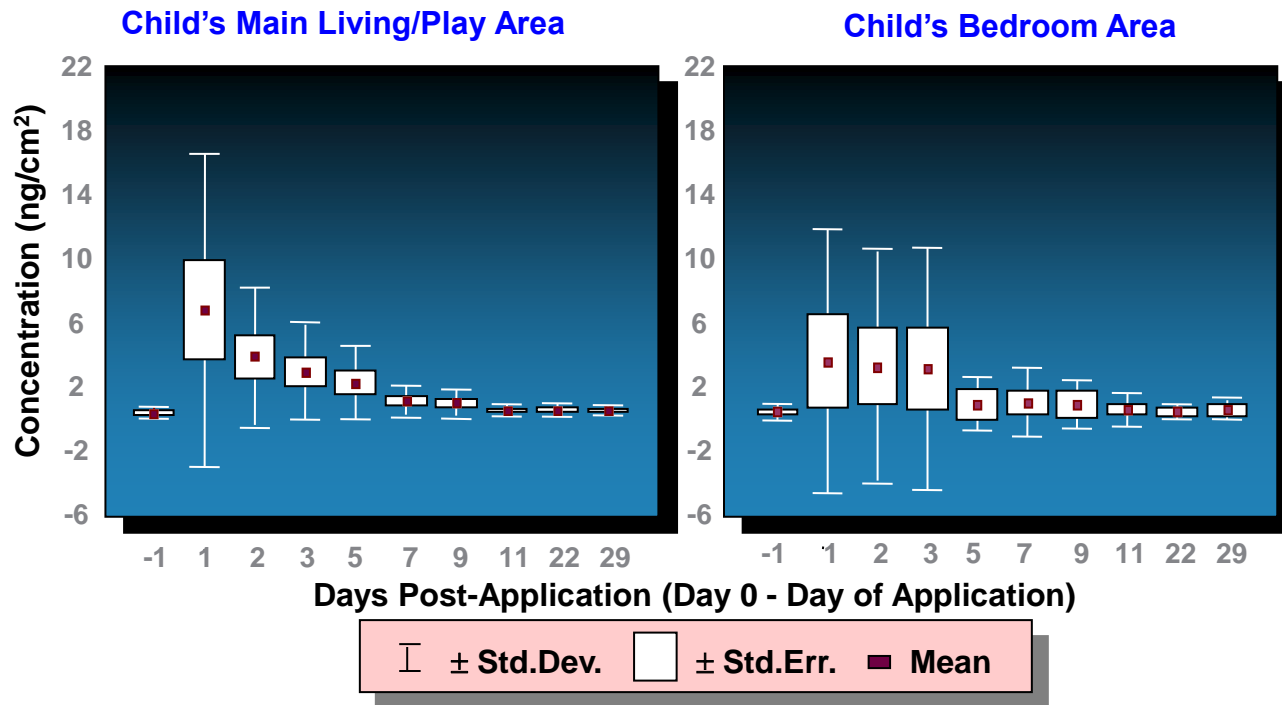


Grid sampling





Chlorpyrifos Dust Wipe Concentrations







Air Sampler

Sampling Times:
Days (-1 to 0), (0-1), (1-2), (2-3), (3-5), (5-7), (7-9) & (9-11).



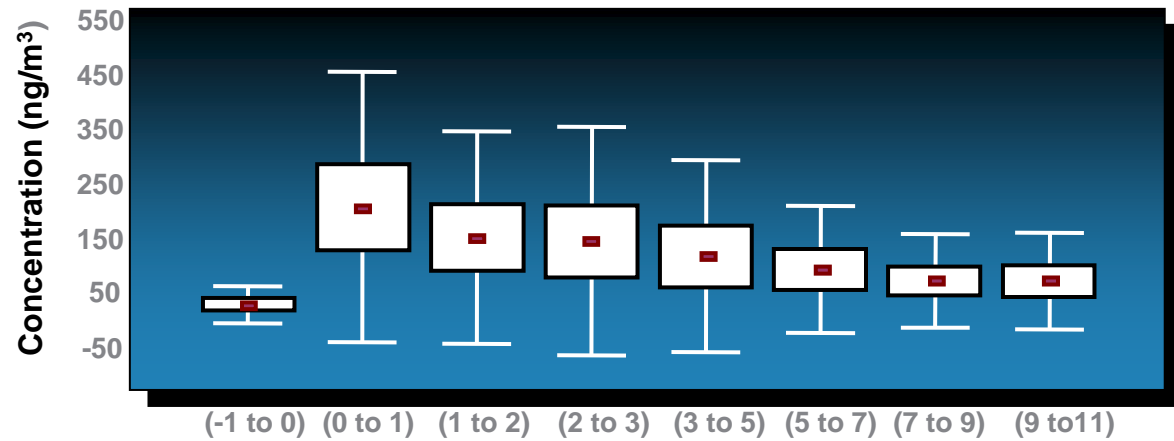
Dust Wipe Sampler

(LWW - Lioy, Weisel, Wainman Sampler)
Sampling Times: Days (-1, 1, 2, 3, 5, 7, 9 & 11)
Sampling Locations: Child's main Living/Play area & bedroom area.

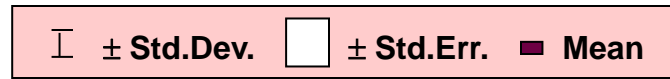


Plush Toys (Placed in home on day 0 post-application). **Sampling Times:** Days 1, 2, 3, 5, 7, 9 & 11.

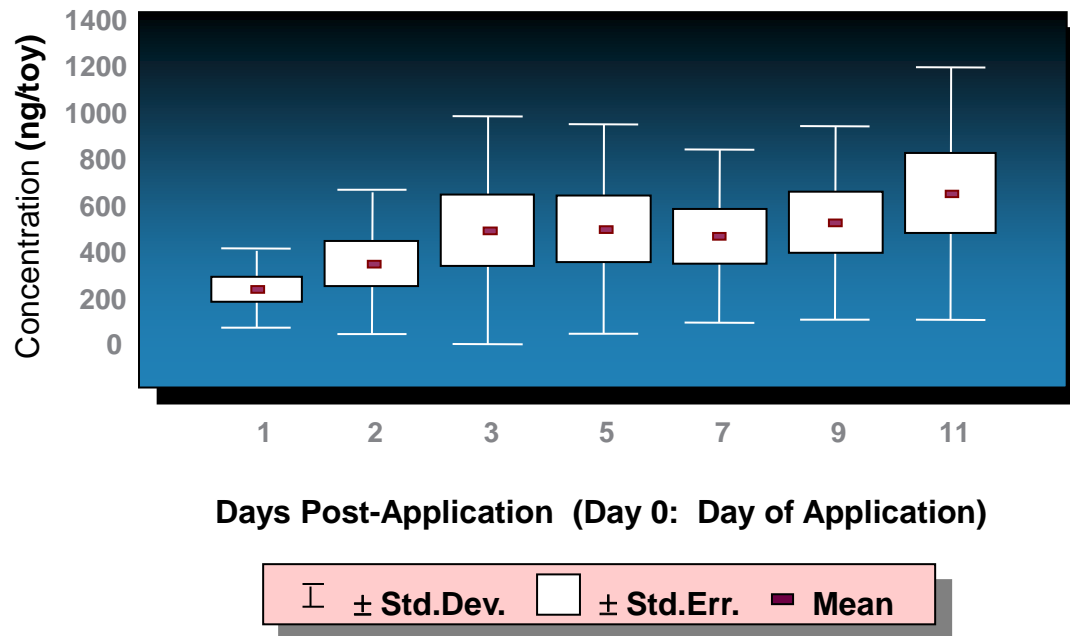
Chloropyrifos Air Concentrations



Days Post – Application (Day 0: Day of Application)



Chlorpyrifos Toy Concentrations

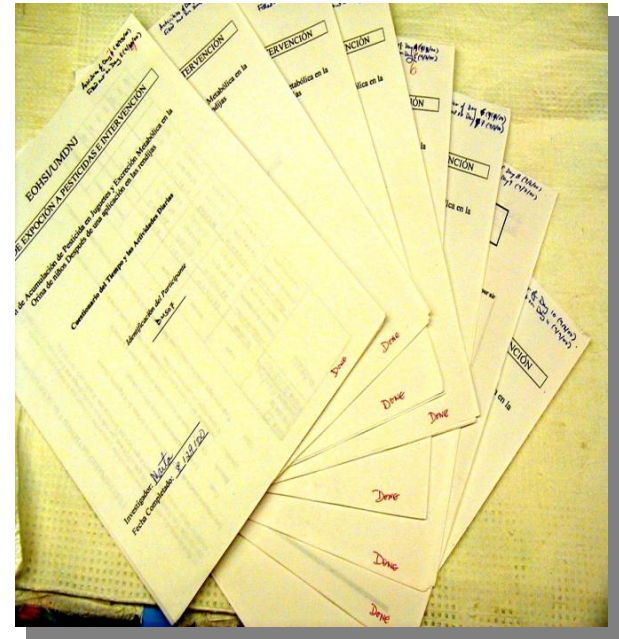




Handrinse
Isopropanol Rinse;
Sampling Times:
Days -1, 2 Pre &
Post & 9.



Urine
Sampling Times:
Morning Void on
Days -1, 1, 2, 3, 5, 7,
9, & 11. Samples
Analyzed by CDC.



Activity Diaries
Maintained to keep a
record of child's
activities.

Support from EPA



Chlorpyrifos; End-Use Products Cancellation Order

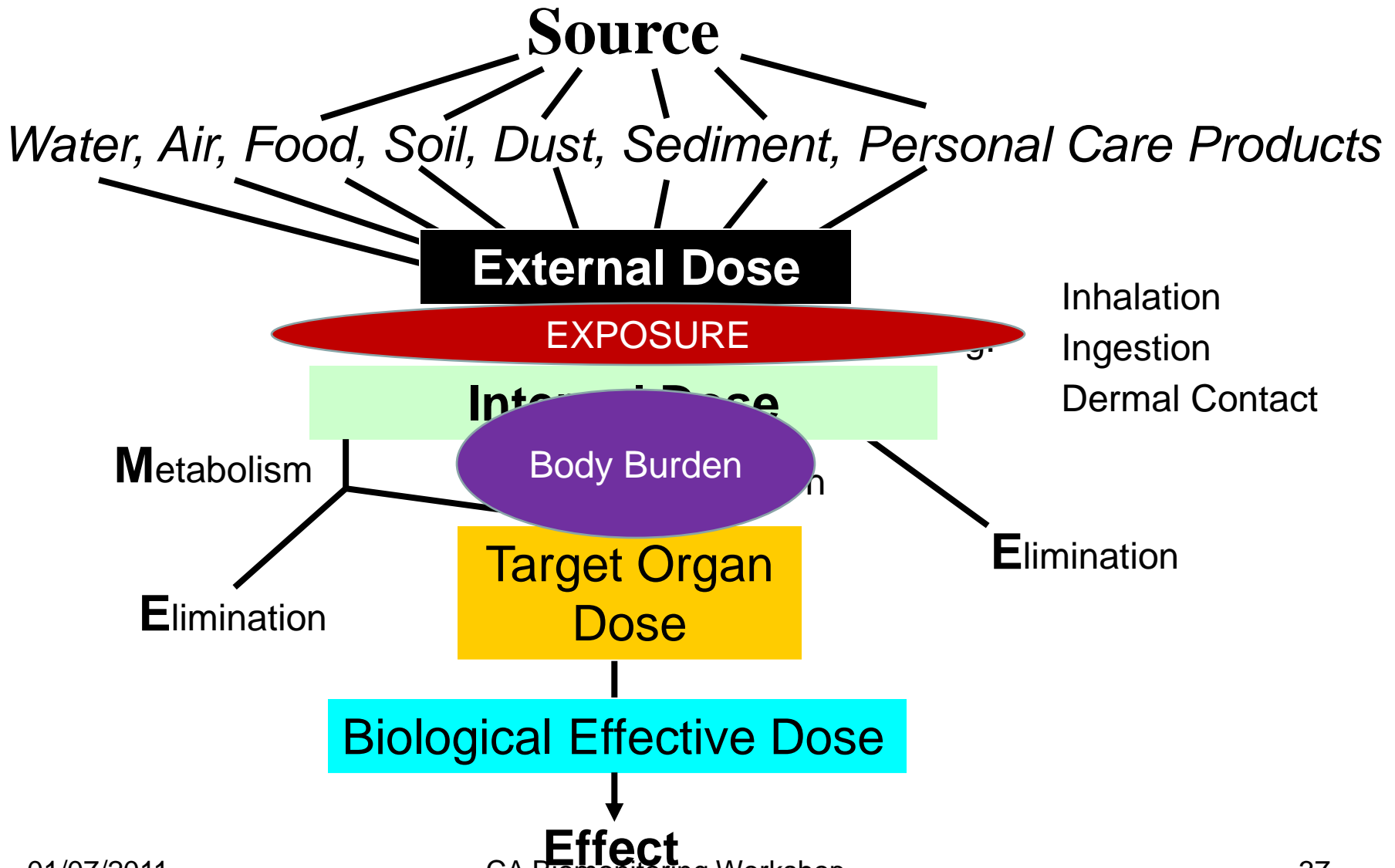
Federal Register: January 25, 2001 (Volume 66, Number 17)

- In a memorandum of agreement (Agreement) effective June 7, 2000, EPA and the basic manufacturers of the active ingredient chlorpyrifos agreed to several voluntary measures that will reduce the potential exposure to children associated with chlorpyrifos containing products.

QUESTIONS?



Exposure Science



P. Hore, et al

- Study conducted in 10 residential homes (criteria for selection: with child age 2-5 years and routinely apply pesticides)
- Crack and crevice application of Dursban (active ingredient chloropyrifos) made to each home by a licensed applicator
- Sampling period: 2 weeks (days -1, 1, 2, 3, 5, 7, 9, and 11)