



Exposure (To Stressors)



Autism Spectrum Disorders

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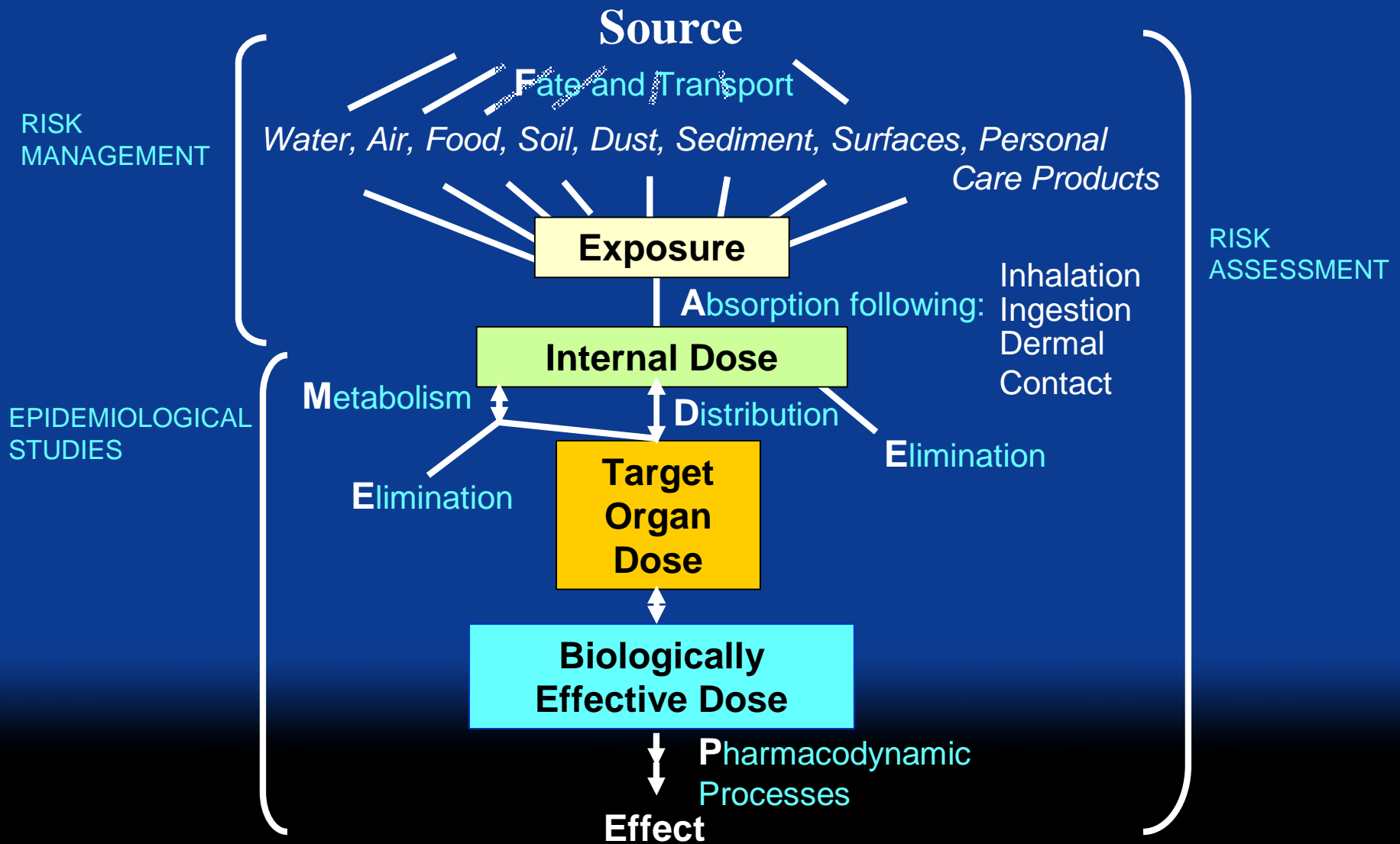
National Center for Environmental Health

Centers for Disease Control and Prevention

Atlanta, GA USA 30341

SAFER • HEALTHIER • PEOPLE™

Exposure-Effect Continuum for Environmental Chemicals



Environmental Stressors

Chemicals

Infectious
Agents

Social

Environmental

Built
Environment

Occupational

Pharmaceuticals

Personal Care
Products

Diet

Household
Products

Individual Stressors

Genetics

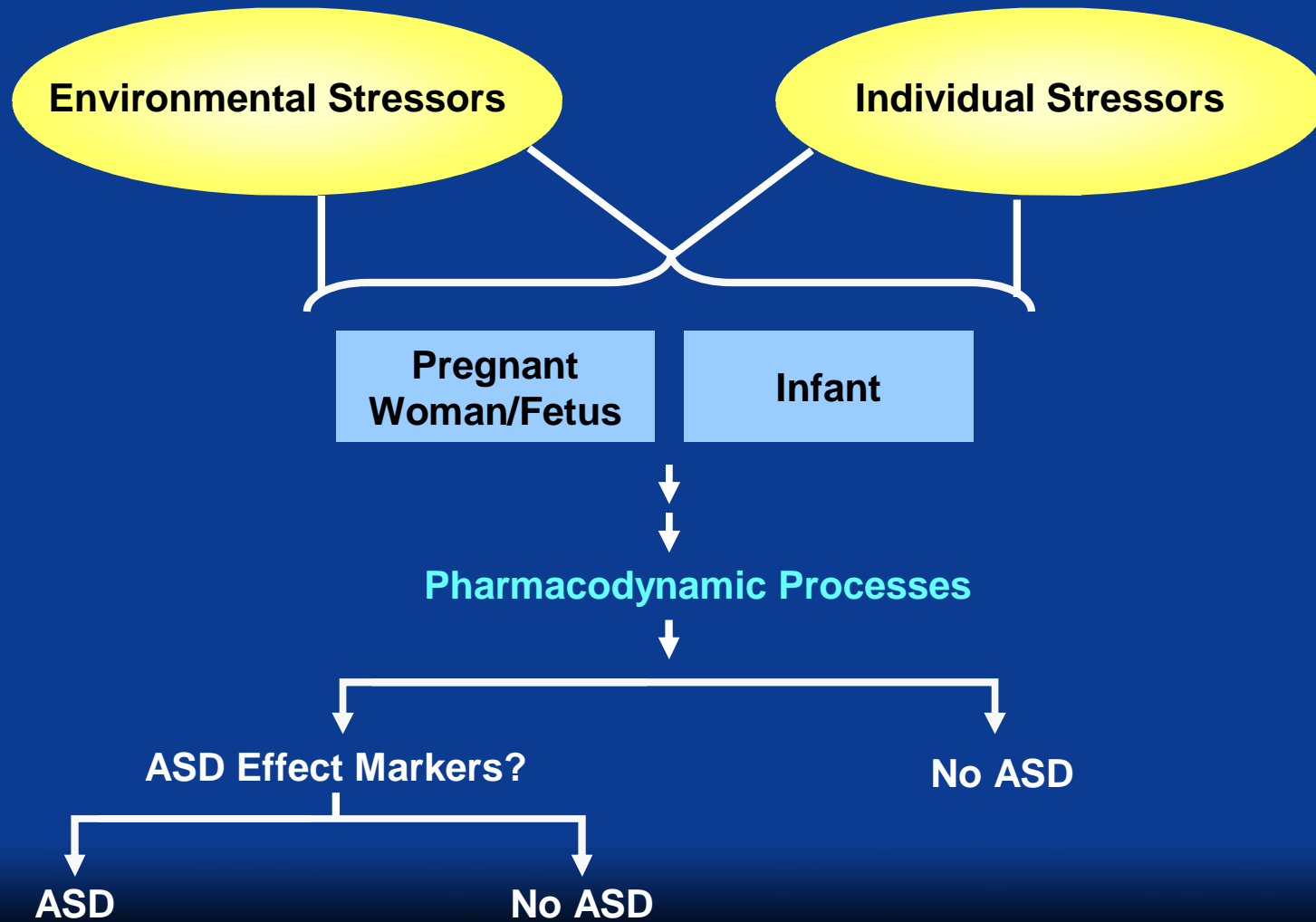
Personal Characteristics

Age

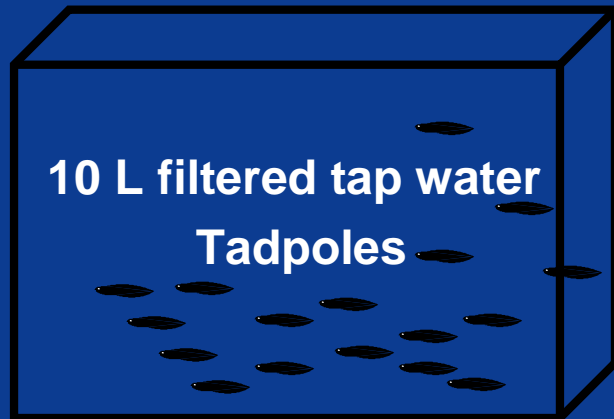
Nutritional Status

Health Status

Sex



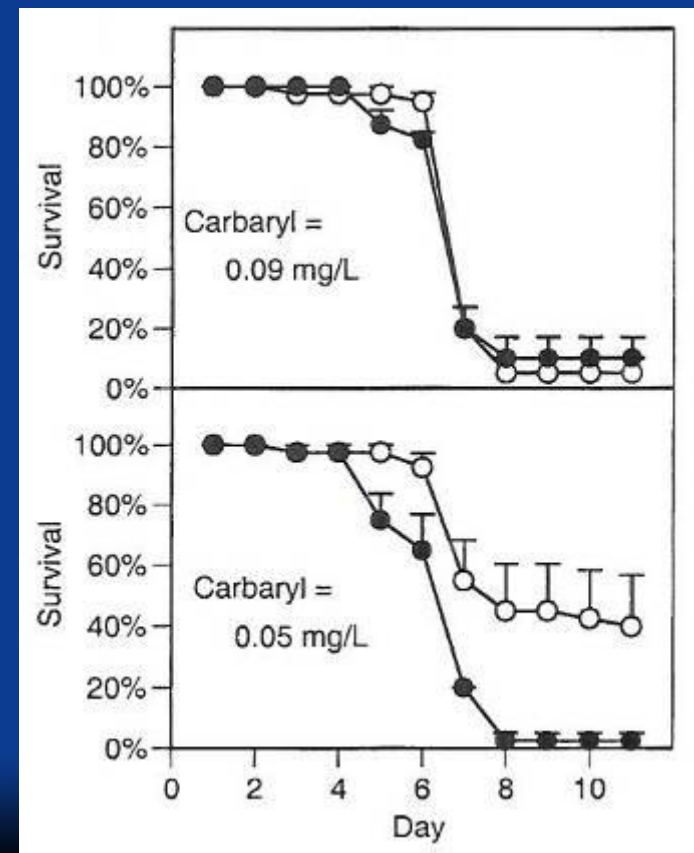
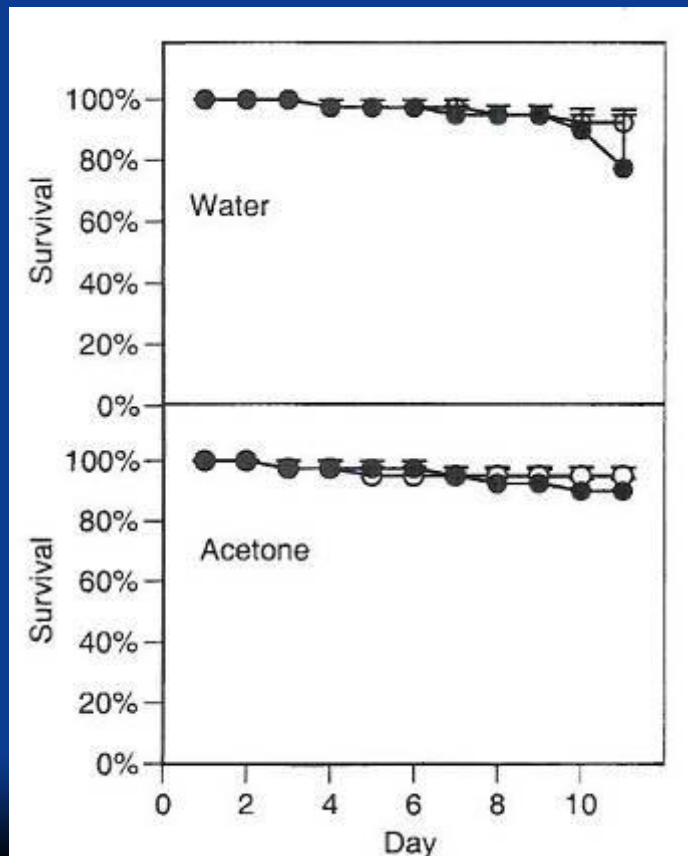
Effects of Multiple Stressors



Add to experimental tub

1. Water control with and without predator
2. Acetone control with and without predator
3. Carbaryl (varying concentrations in acetone) with and without predator

Survival Results



Relyea and Mills. PNAS 98: 2491-2496 (2001)

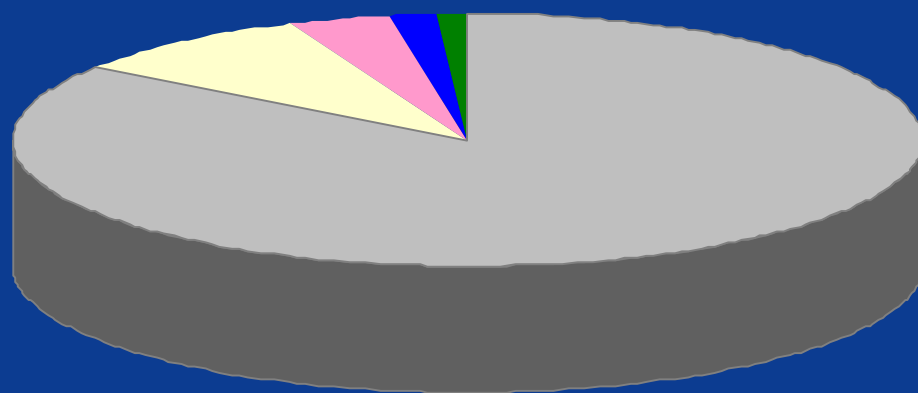
Environmental Stressors

- I **Chemicals**
- I Infectious Agents
- I Social

Chemical Exposures

- I Environmental
- I Occupational
- I Medications
- I Personal Care Products
- I Diet

Number of Chemicals in Commerce - USA



- "industrial", ~82,000
(~40% polymers)
- Food additives,
~8600
- Cosmetic ingredients,
~3400
- Pharmaceuticals,
~1800
- Pesticides (active),
~1000

Chemical Exposure Assessment

- I Where do we start?
- I What's available for monitoring?

Exposure Assessment Approaches



- | Questionnaire/Historical Information (includes GIS + video)
- | Environmental monitoring (Air, Water, Food, Soil, Personal)
- | Biomonitoring

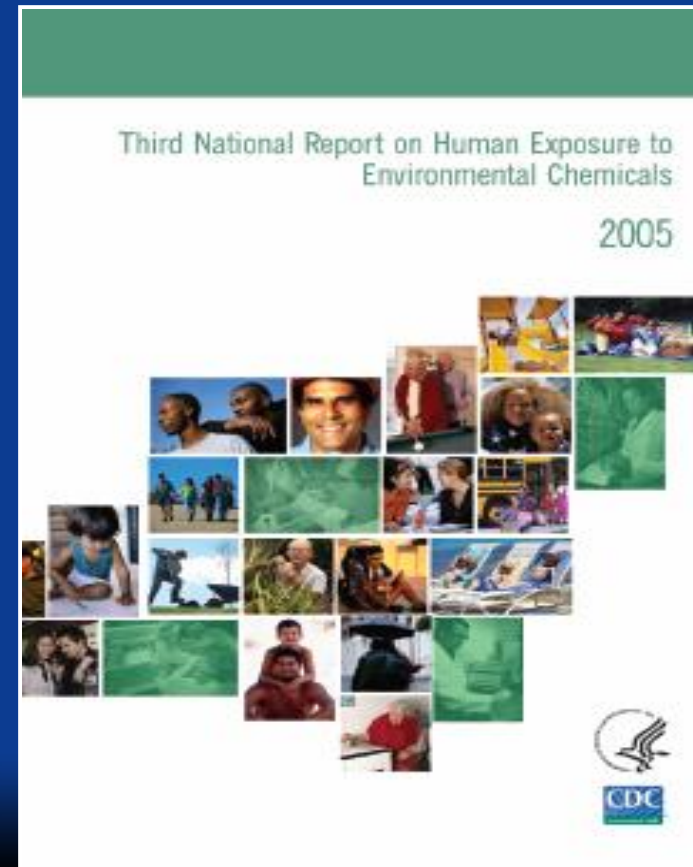
- | Combine these 3 approaches with calibrated and validated models

Chemicals in 4th Report

~265 chemicals 2003-2004

Exposure biomarkers for:

- | Metals
- | Polychlorinated biphenyls, dioxins and furans
- | Organochlorine pesticides
- | Carbamate pesticides
- | Organophosphorous pesticides
- | Pyrethroid pesticides
- | Herbicides
- | Polycyclic aromatic hydrocarbons
- | Phthalates
- | Phytoestrogens
- | Pest repellants
- | Cotinine
- | Perfluorinated chemicals
- | BFRs
- | VOCs
- | Perchlorate
- | Bisphenol A & Alkylated phenols
- | Triclosan
- | Sunscreen agent
- | Speciated arsenic
- | Acrylamide
- | Parabens



www.cdc.gov/exposurereport

Choosing the Appropriate Matrix

- I Chemical dependent
- I Population dependent (age, race, health status, etc.)

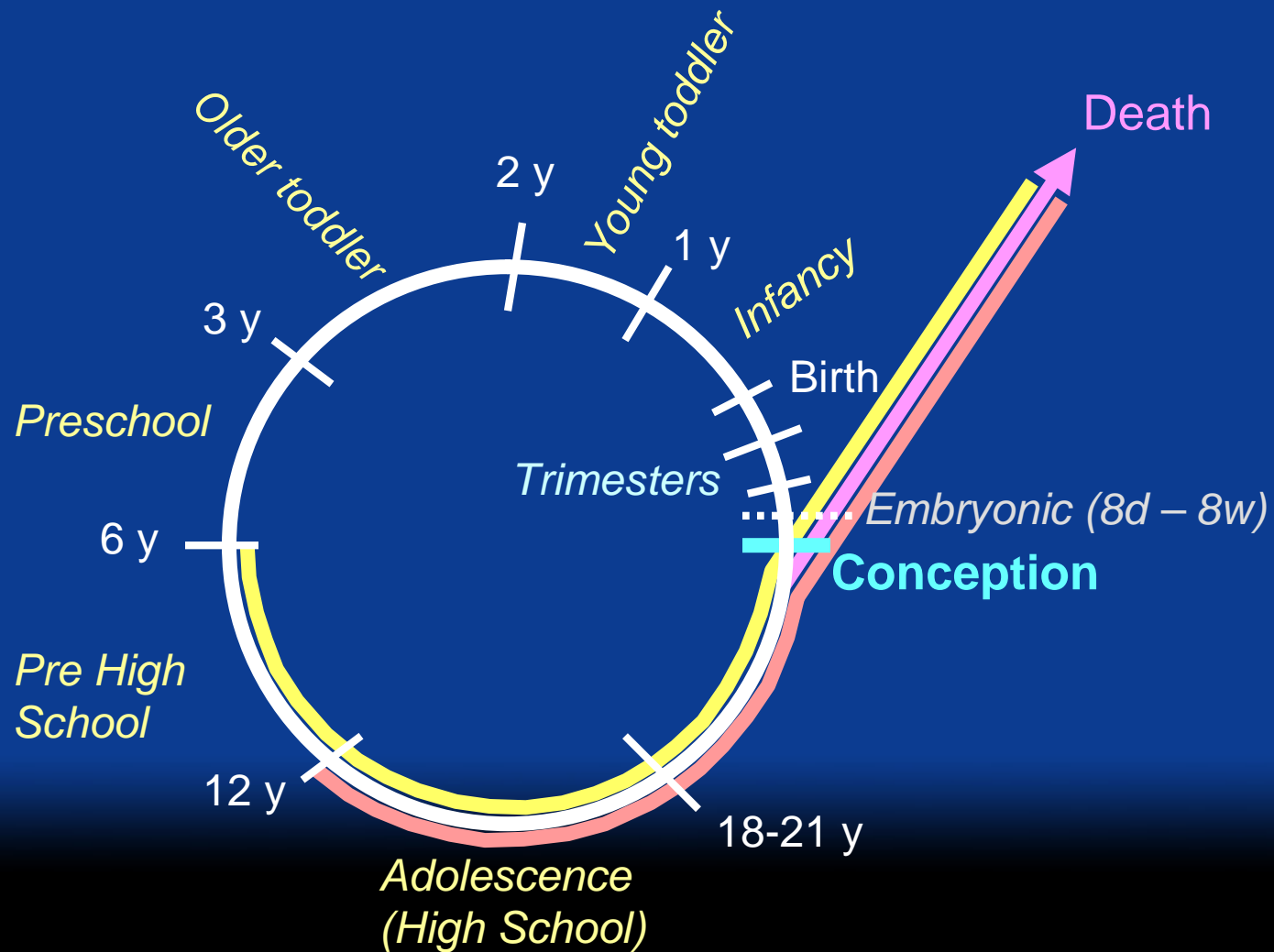
Selection of Biomonitoring Matrix: Environmental Chemical Dependent

I Two primary classes of Environmental Chemicals

- u Persistent (half-lives in years); PCDDs, PCBs, PBDEs, PFCs, OCs, Pb
- u Non Persistent (half-lives in minutes/hours); phthalates, pesticides (OPs, carbamates, pyrethroids), VOCs

So where do we start?

Selection of Biomonitoring Matrix: Population Dependent Life Stages of Children



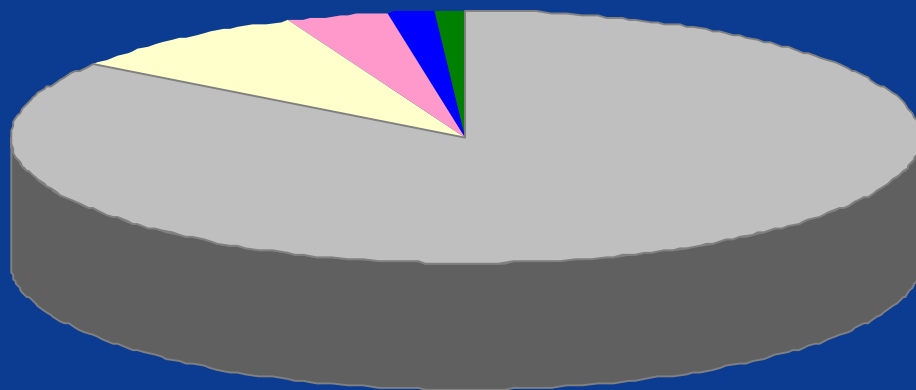
Relative Importance of Various Biological Matrices for Measuring Exposure During the Different Life Stages

Matrices	Adult preconception	Fetal			0-1 year	2-3 years	4-11 years
		1st	2nd	3rd			
Persistent Organic Chemicals							
Blood (whole)	1				1	1	1
Blood (serum)	1				1	1	1
Blood (plasma)	1				1	1	1
Urine	3				3	3	3
Saliva	3				NA	3	3
Hair	3				3	3	3
Nails	3				3	3	3
Adipose Tissue	1				NA	NA	NA
Feces	3				3	3	3
Semen	3				NA	NA	NA
Breath	3				NA	3	3
Teeth	NA				NA	NA	3
Cord Blood	1	1	1	1	3	3	3
Meconium	3	2	2	2	3	3	3
Milk (maternal)	1	1	1	1	1	3	3
Blood (maternal)	1	1	1	1	1	3	3
Urine (maternal)	3	3	3	3	3	3	3
Hair (maternal)	3	3	3	3	3	3	3

Barr, Wang, and Needham. Environ Health Perspect **113**:1083-91 (2005)

So where do we start?

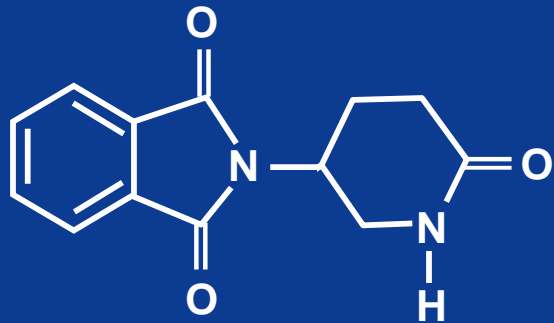
Number of Chemicals in Commerce - USA



- "industrial", ~82,000 (~40% polymers)
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- Pharmaceuticals, ~1800
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- | Which chemicals are absorbed?
- | Which chemicals are increasing in environment? People?
- | Which chemicals are neuroactive? Cause oxidative stress?
- | Which chemicals have structures similar to chemicals linked to ASD?

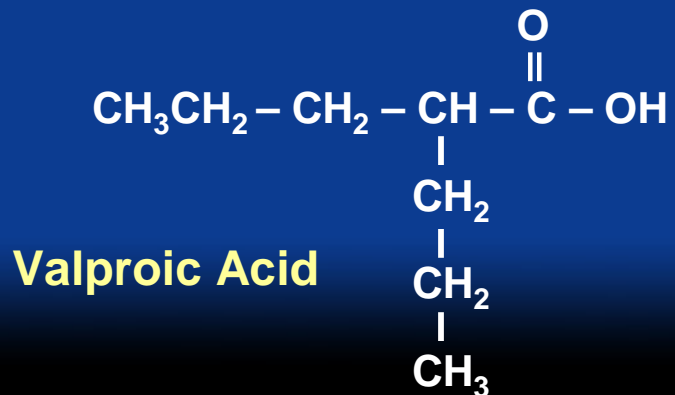
Chemicals Linked to ASD



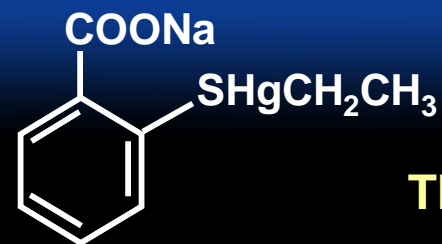
Thalidomide

Pb
Lead

CH₃CH₂OH
Ethanol



Valproic Acid



Thimerosal

What information can be gained from
nested case-control studies?
sibling and twin studies?
National Children's study?
National Children's Centers?

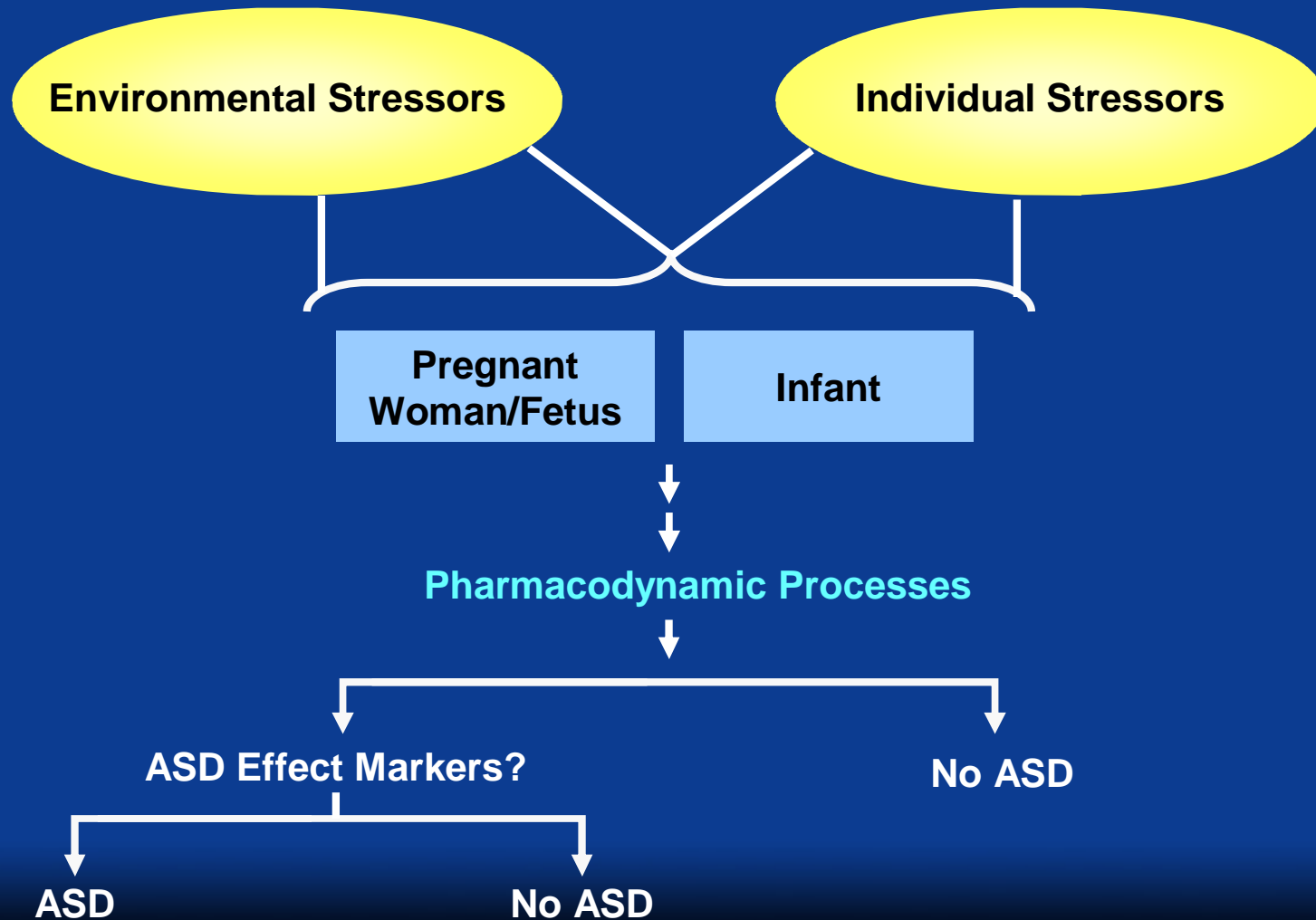
These will require “casting a wide net”
analytically or better information to select
the analytes.

Wider net includes

Time of flight mass spectrometry/2D GC

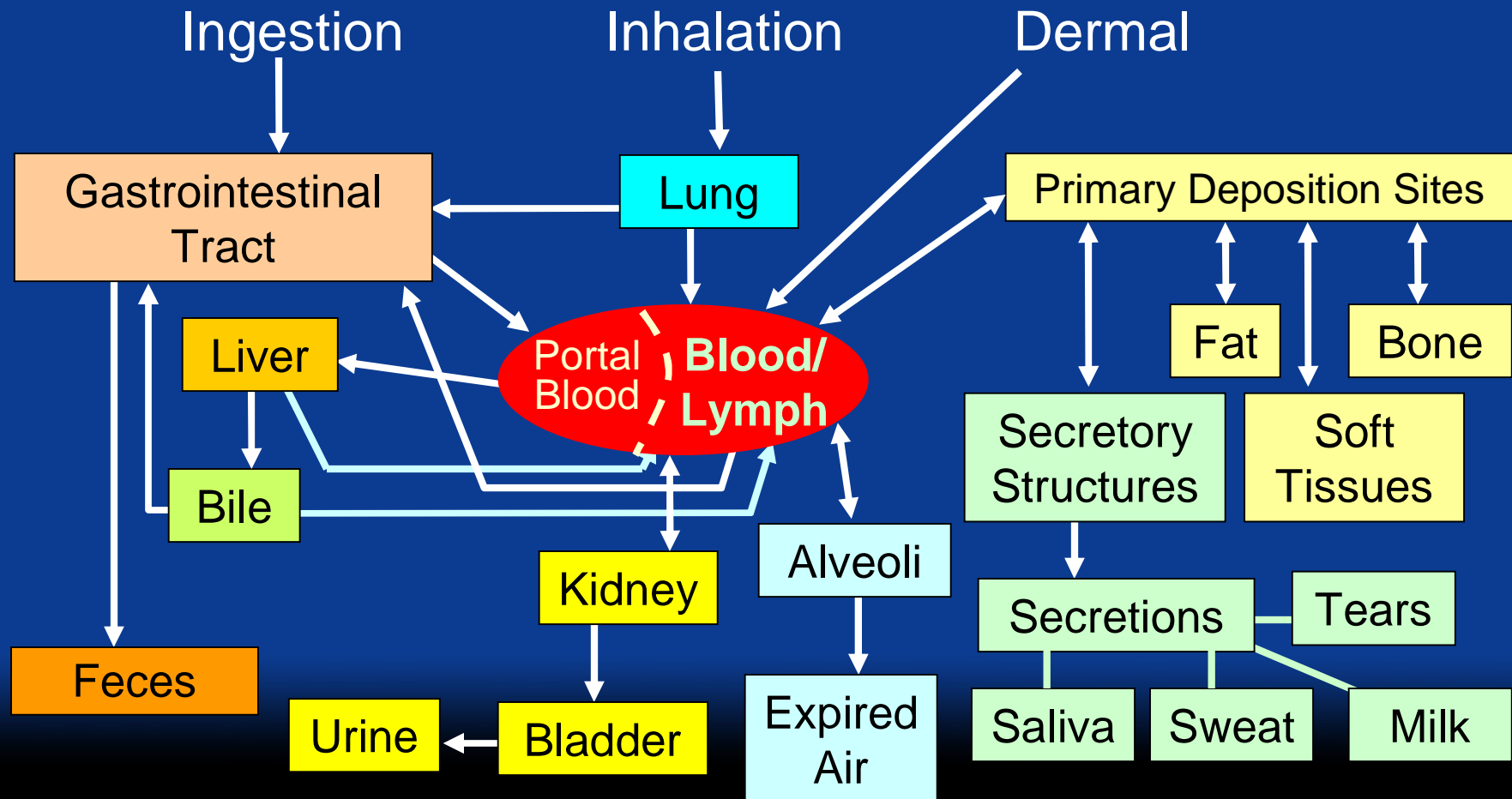
Biosensors

“Working backwards”

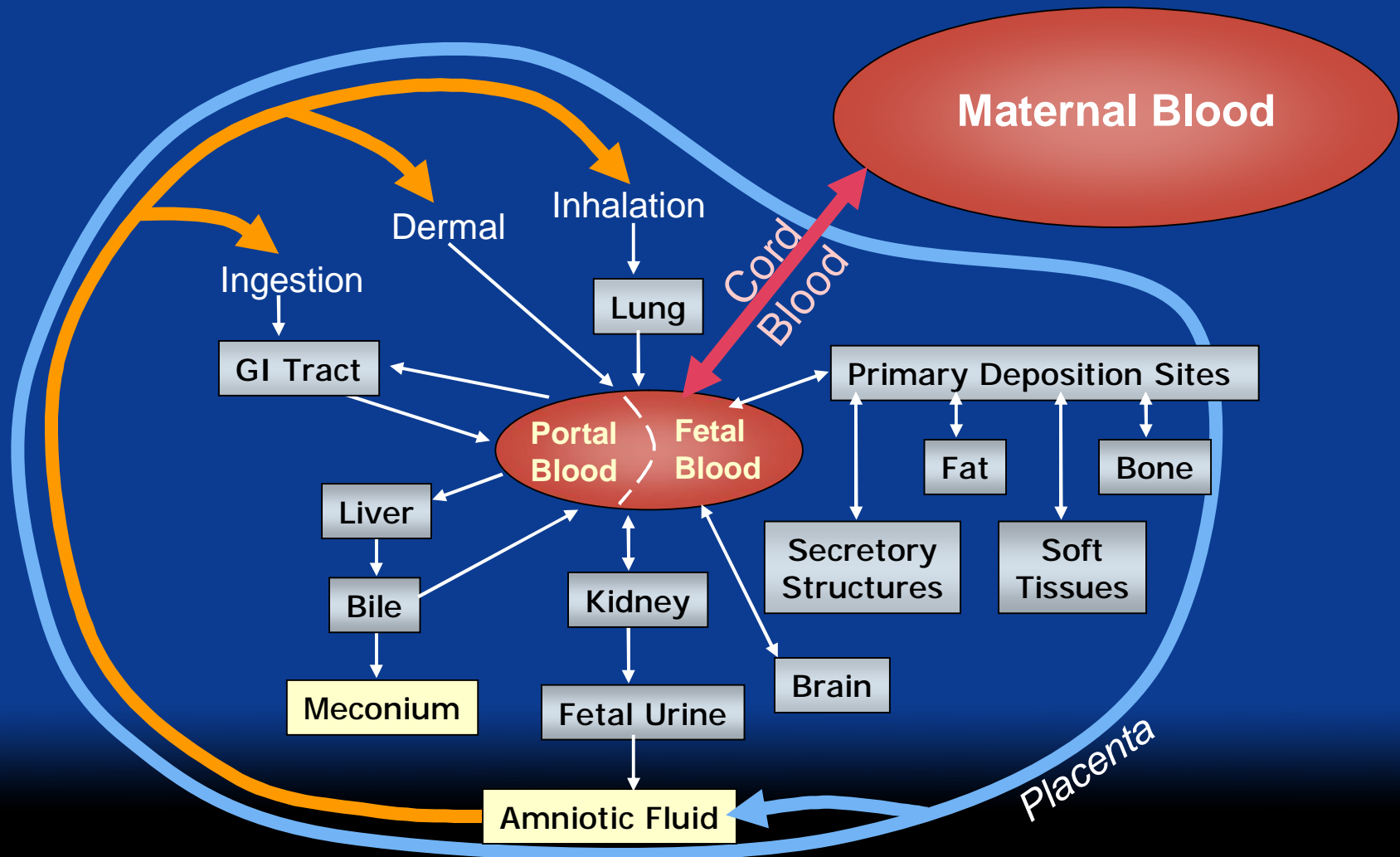


How do concentrations in particular matrix
reflect body burden?

Absorption, Distribution, and Elimination of Environmental Chemicals in the Body



Fetal Period/Fetal Environment



Biomonitoring for Disease Prevention

