

**The Pervasive Herbicide, Roundup:
Evidence that It Is Toxic to Humans**

**Stephanie Seneff
MIT CSAIL**

Outline

- Introduction: Focus on Autism (自閉症)
- Is Glyphosate (草甘膦) Toxic?
- Manganese (錳) Dysbiosis
- Anemia (貧血) and Vitamin D Deficiency (維生素D缺乏症)
- Many Animal Species under Stress
- Summary

Introduction

US Health Status

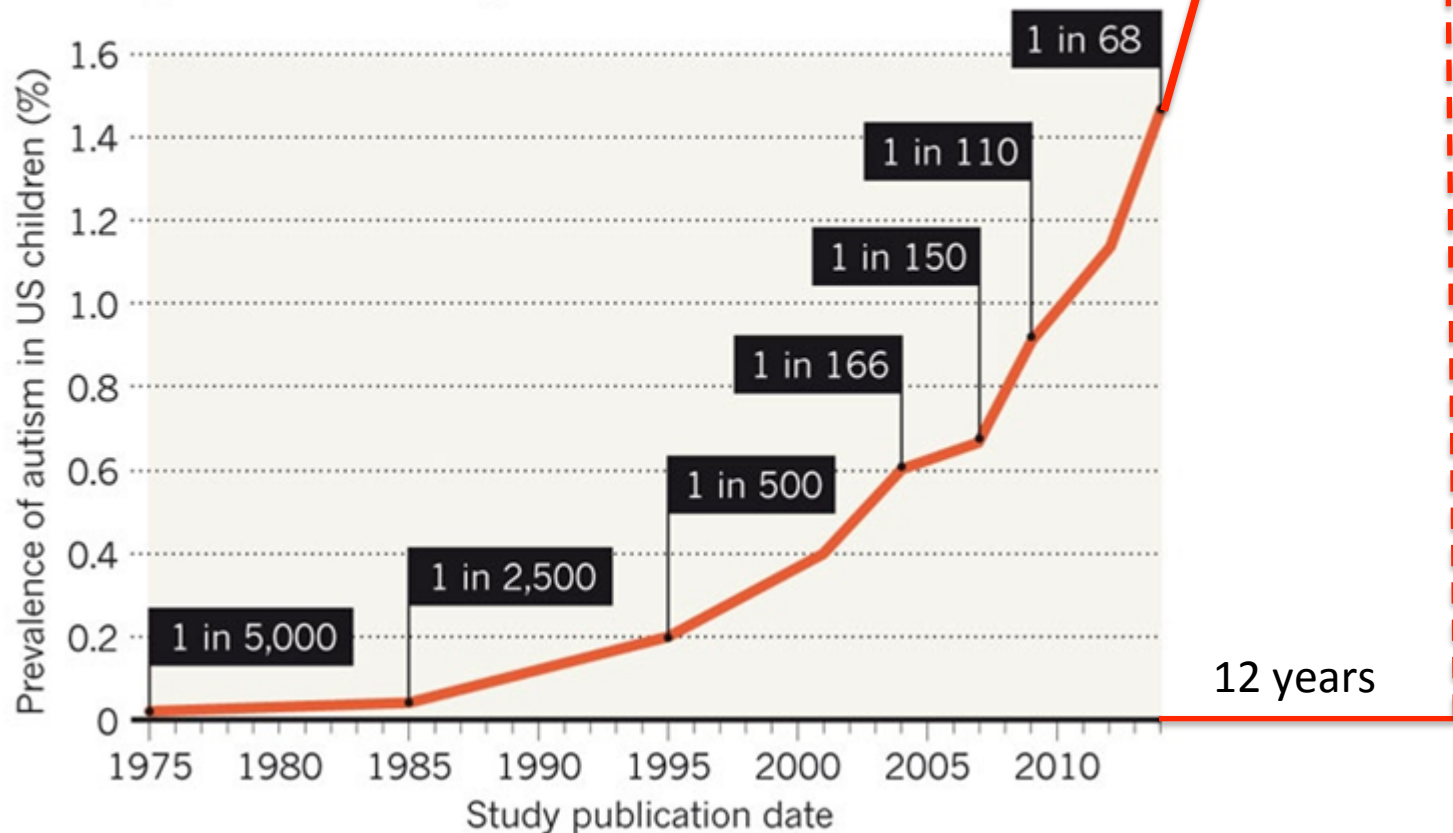
- US makes up 5% of the world's population but consumes more than 50% of the world's pharmaceutical drugs
- We spend more on health care than Japan, France, China, UK, Italy, Canada, Brazil, Spain, and Australia, *combined*
- US ranks last or near last among developed nations on infant mortality and life expectancy
- We also suffer from more chronic illnesses
- *We consume 25% of the world supply of glyphosate*

A Frightening Trend*



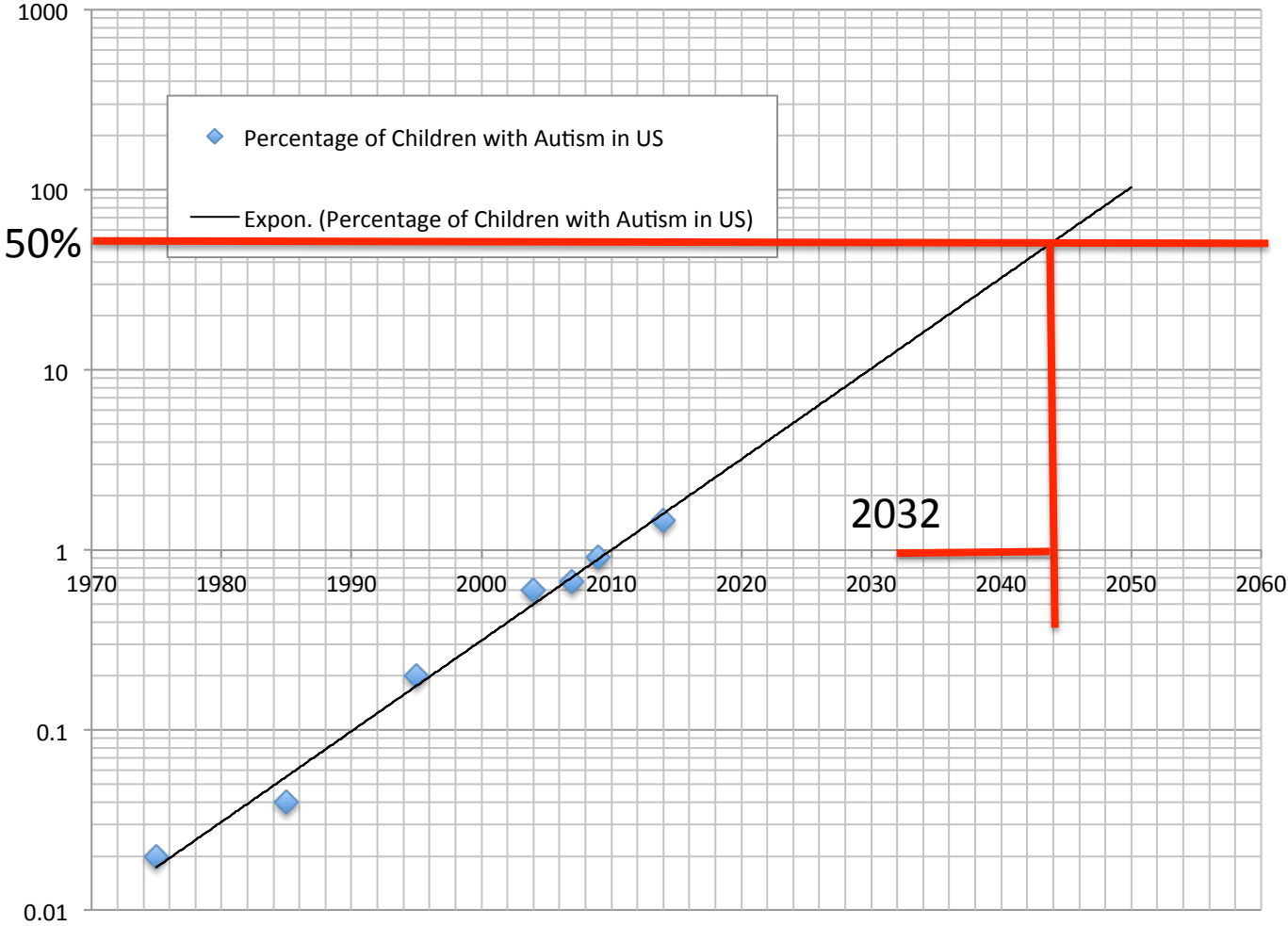
AUTISM DIAGNOSES RISING

Almost 1.5% of US children are now diagnosed with autism, according to data from 11 regions in the United States.

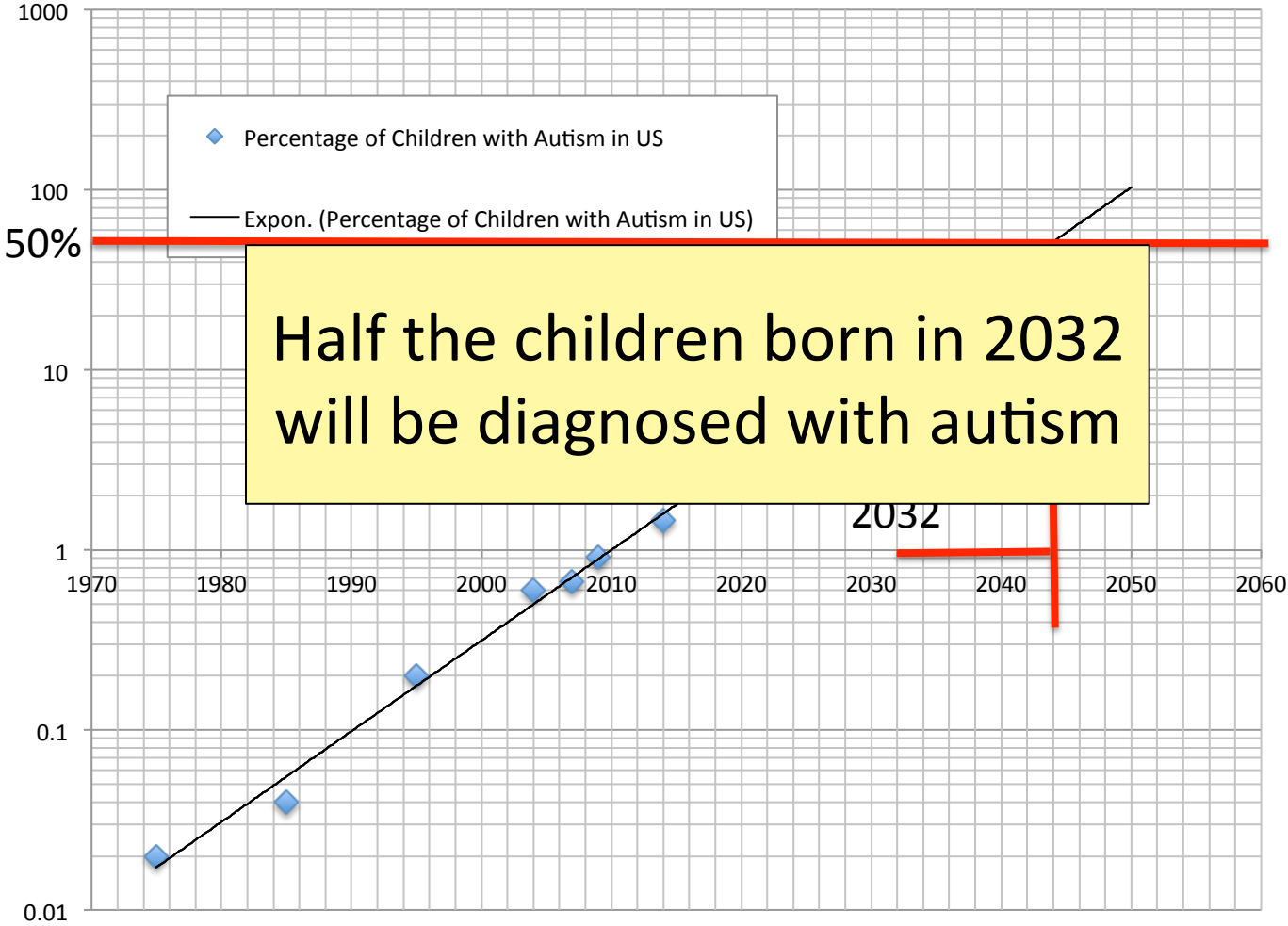


*K. Weintraub, Nature 479, Nov. 3 2011, 22-24.

Percentage of children with Autism in the US



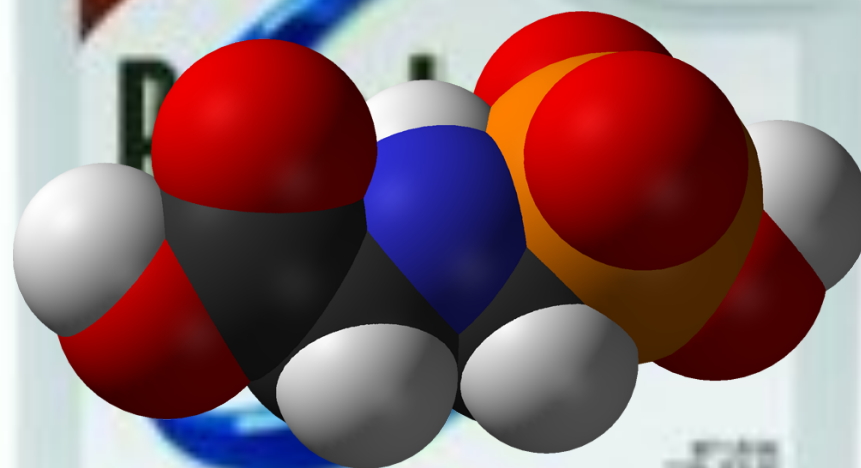
Percentage of children with Autism in the US



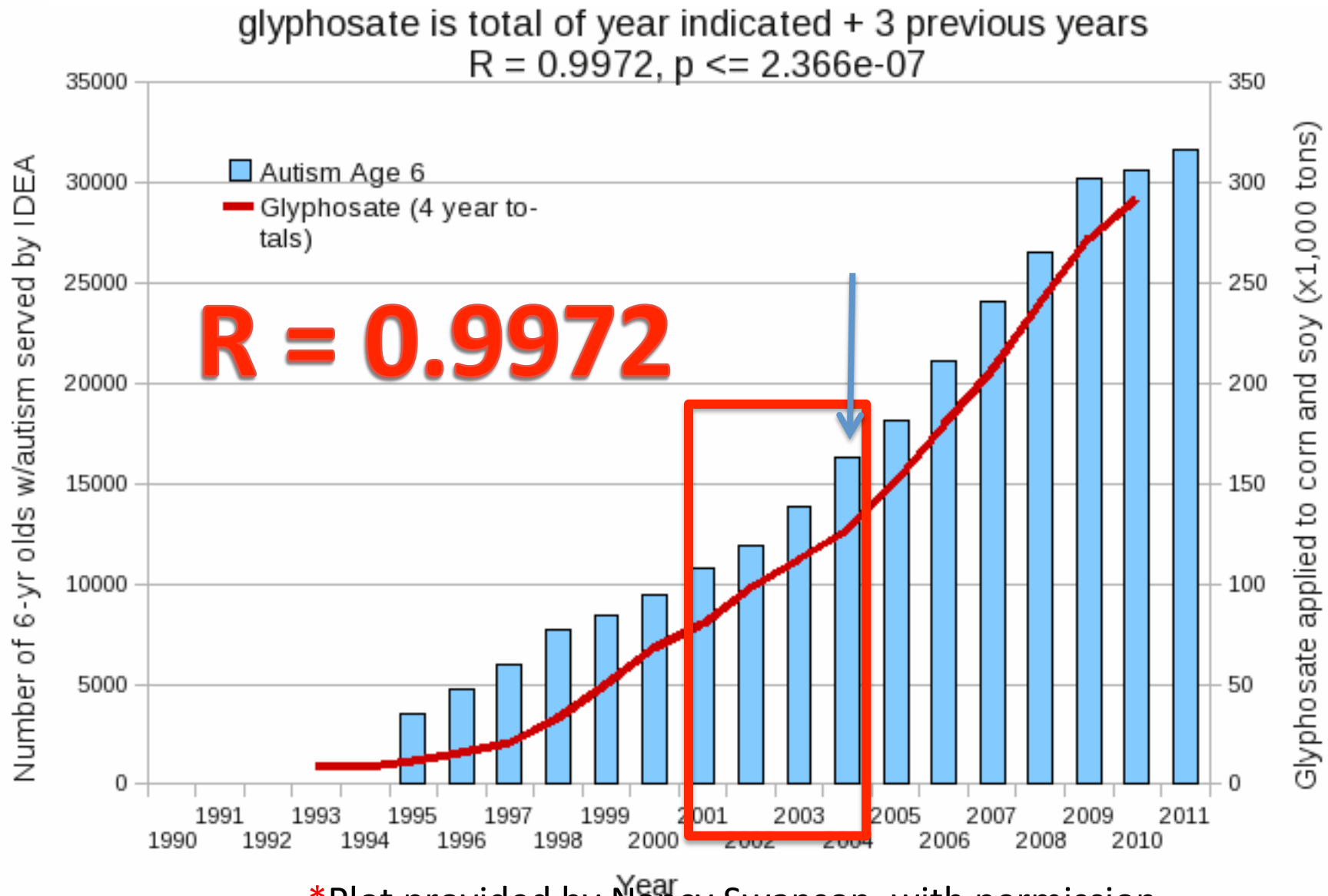
“If it is an environmental cause contributing to an increase, we certainly want to find it.”*

*K. Weintraub, Nature 479, Nov. 3 2011, 22-24.

草甘膦



Autism Prevalence: 6 year olds

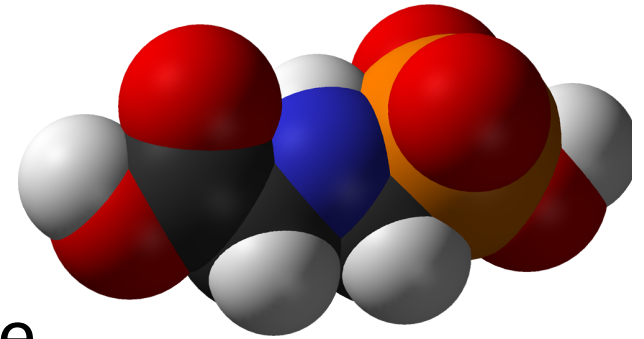


* Plot provided by Nancy Swanson, with permission

Data sources: autism: US Department of Education; Glyphosate: US Department of Agriculture

Is Glyphosate Toxic?

Is Glyphosate Toxic?



- Monsanto has argued that glyphosate is harmless to humans because our cells don't have the shikimate pathway, which it inhibits
- However, our gut bacteria DO have this pathway
 - We depend upon them to supply us with essential amino acids (氨基酸) (among many other things)
- Other ingredients in Roundup greatly increase glyphosate's toxic effects
- Insidious effects of glyphosate accumulate over time
 - Most studies are too short to detect damage

Adoption of “Roundup Ready” Crops in US*

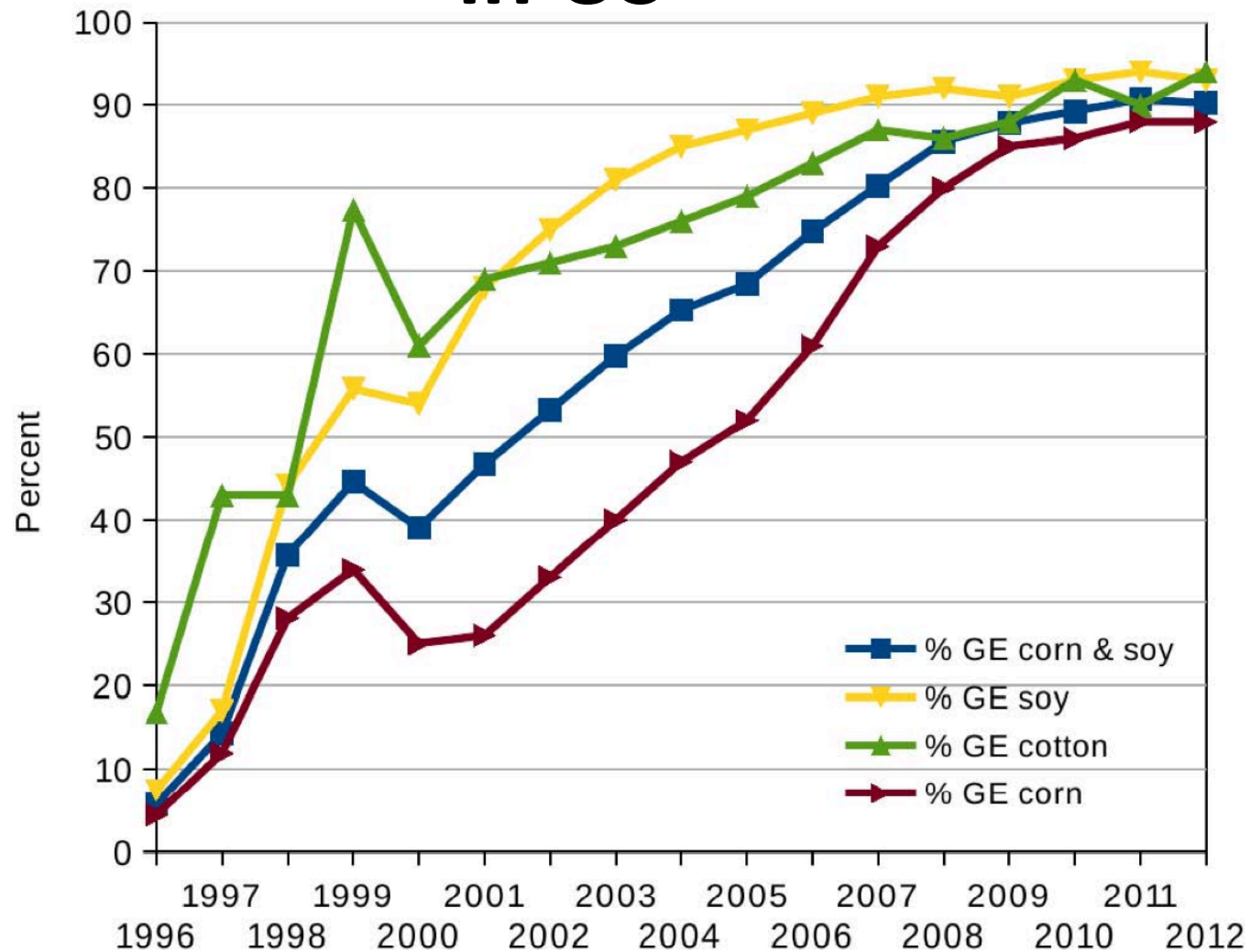


Figure 1. Adoption of GE crops in US.

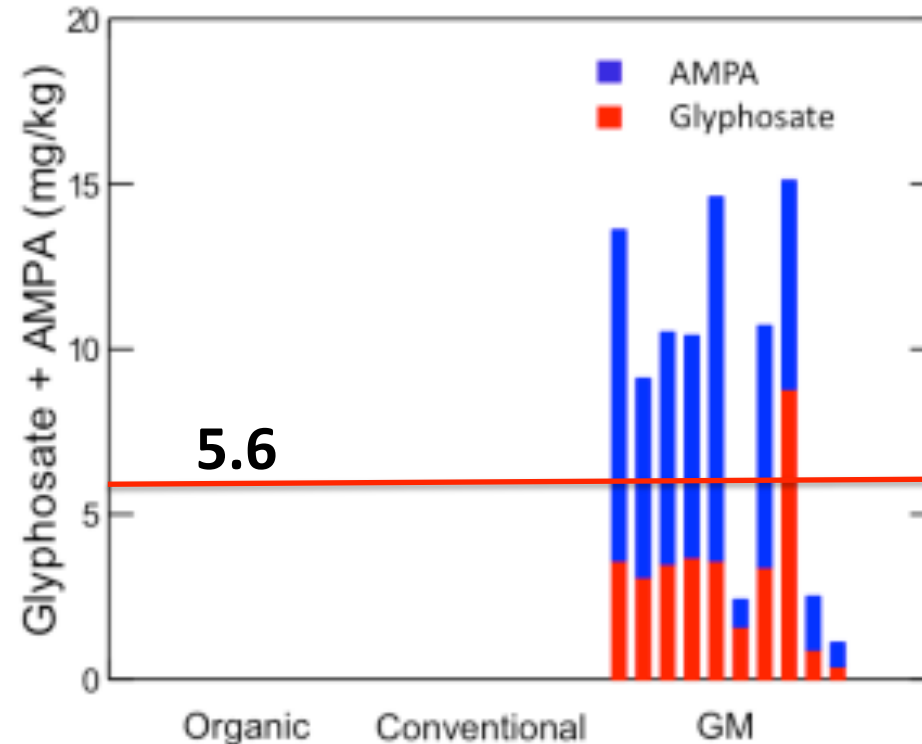
* N. Swanson et al., Journal of Organic Systems 20145;9(2): 6-37.

Why Sugar is Bad For You!

- Beet sugar is derived from GMO Roundup-Ready beets
- High fructose corn syrup is derived from GMO Roundup Ready corn
- Cane sugar is derived from sugar cane that's sprayed with Roundup right before the harvest for ripening



Study of glyphosate and AMPA (breakdown product) residues in soy crops*



“Another claim of Monsanto's has been that residue levels of up to **5.6** mg/kg in GM-soy represent “...*extreme levels*, and far higher than those typically found” (Monsanto 1999).

Paper Published in 2012

Entropy **2013**, *15*, 1416-1463; doi:10.3390/e15041416

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entropy

ISSN 1099-4300

www.mdpi.com/journal/entropy

Review

Glyphosate's Suppression of Cytochrome P450 Enzymes and Amino Acid Biosynthesis by the Gut Microbiome: Pathways to Modern Diseases

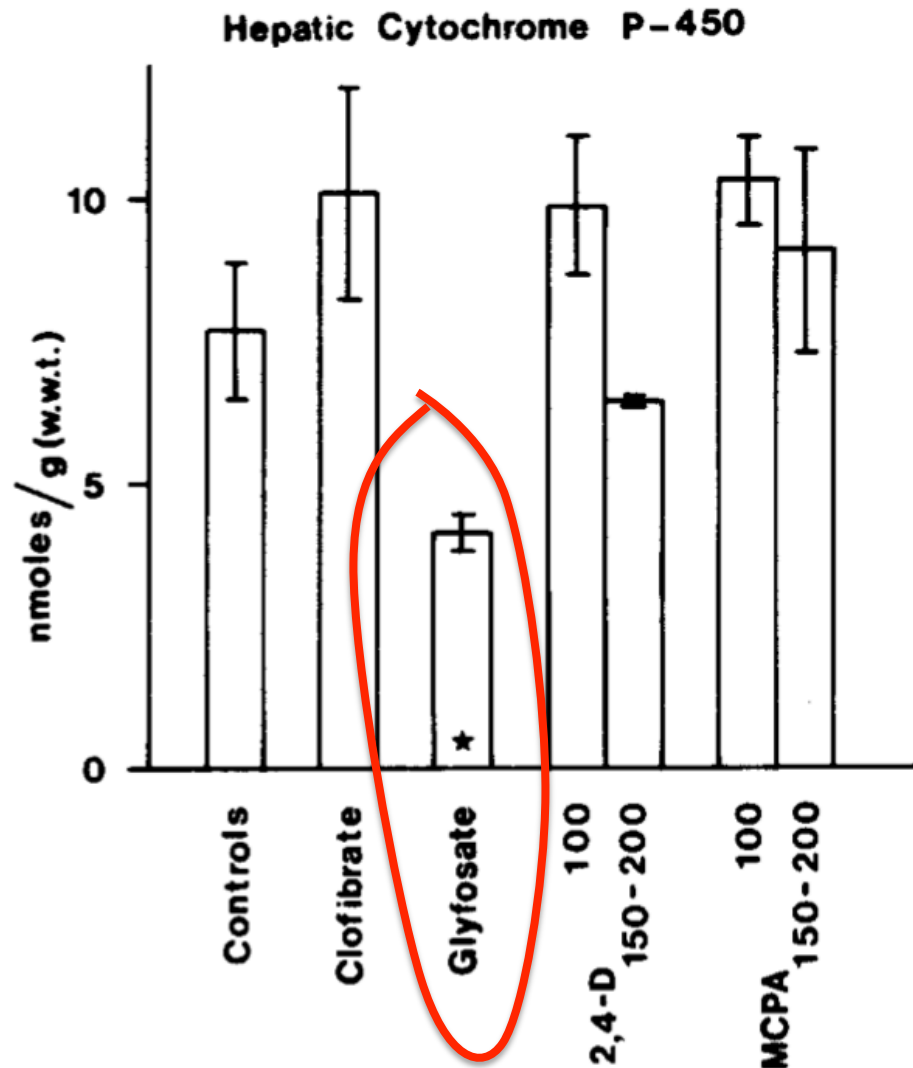
Anthony Samsel¹ and Stephanie Seneff^{2,*}

Main Toxic Effects of Glyphosate*

- Kills beneficial gut bacteria and allows pathogens (病原體) to overgrow
- Interferes with function of cytochrome P450 (CYP) enzymes
- Chelates important minerals (螯合礦物質) (iron, cobalt, manganese, etc.)
- Interferes with synthesis of aromatic amino acids and methionine (蛋氨酸)
 - Leads to shortages in critical neurotransmitters (神經遞質) and folate (葉酸)
- Disrupts sulfate synthesis (合成硫酸) and sulfate transport (硫酸運輸)

*Samsel and Seneff, *Entropy* **2013**, 15, 1416-1463

Inhibition of Cytochrome P450 Enzymes (CYPs) by Various Pesticides*



Study in rats on 2,4-D, clofibrate, MCPA, and glyphosate

*E Hetanen et al., Acta Pharmacol. Et Toxicol. 1983, 53, 103-112.

The Enhancing Effect of Adjuvants*

“ 佐劑 in pesticides are generally declared as 惰性的 and for this reason they are not tested in long-term regulatory experiments. It is thus very surprising that they amplify *up to 1000 times* the toxicity of their APs [Active Principles] in 100% of the cases where they are indicated to be present by the manufacturer.”

*R. Mesnage et al. BioMed Research International 2014; Article ID:179691.

Roundup Safety Claims Disputed*

“It is commonly believed that Roundup is among the safest pesticides. ... Despite its reputation, *Roundup was by far the most toxic among the herbicides and insecticides tested.* This inconsistency between scientific fact and industrial claim may be attributed to huge economic interests, which have been found to falsify health risk assessments and *delay health policy decisions.*”

*R. Mesnage et al., Biomed Research International, Volume 2014 (2014), Article ID 179691

Paper by NL Swanson *et al.*

Journal of Organic Systems, 9(2), 2014

ORIGINAL PAPER

Genetically engineered crops, glyphosate and the deterioration of health in the United States of America

Nancy L. Swanson¹, Andre Leu^{2*}, Jon Abrahamson³ and Bradley Wallet⁴

¹ *Abacus Enterprises, Lummi Island, WA, USA*

² *International Federation of Organic Agricultural Movements, Bonn, Germany*

³ *Abacus Enterprises, Lummi Island, WA, USA*

⁴ *Crustal Imaging Facility, Conoco Phillips School of Geology and Geophysics, University of Oklahoma, USA*

* *Corresponding author: andreleu.al@gmail.com*

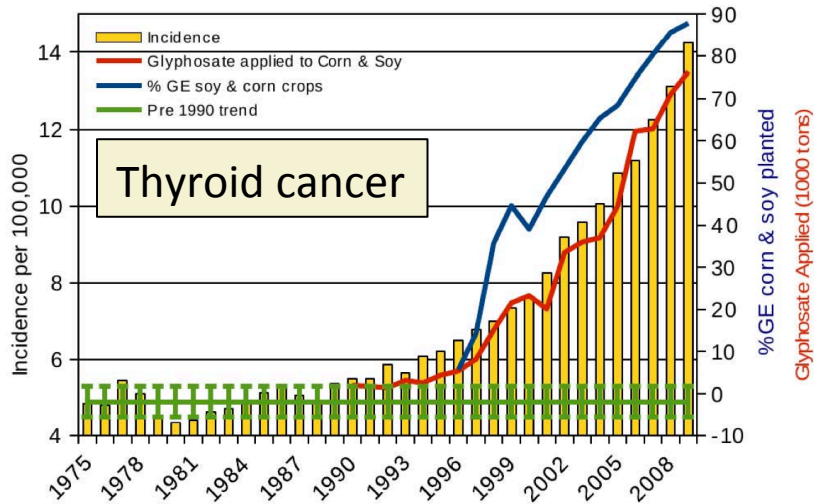
Quote from the Conclusion*

“Although correlation does not necessarily mean causation, when correlation coefficients of over 0.95 (with *p*-value significance levels less than 0.00001) are calculated for a list of diseases that can be directly linked to glyphosate, via its known biological effects, it would be imprudent not to consider causation as a plausible explanation.”

*NL Swanson et al. Journal of Organic Systems 9(2), 2014, p. 32,

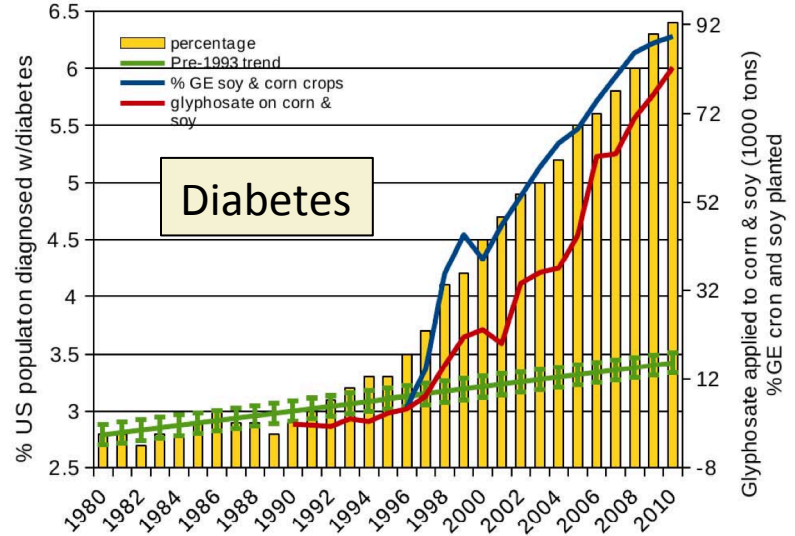
Thyroid Cancer Incidence Rate (age adjusted)

plotted against glyphosate applied to U.S. corn & soy ($R = 0.988$, $p \leq 7.612e-09$)
 along with %GE corn & soy crops $R = 0.9377$, $p \leq 2.152e-05$
 sources: USDA:NASS; SEER



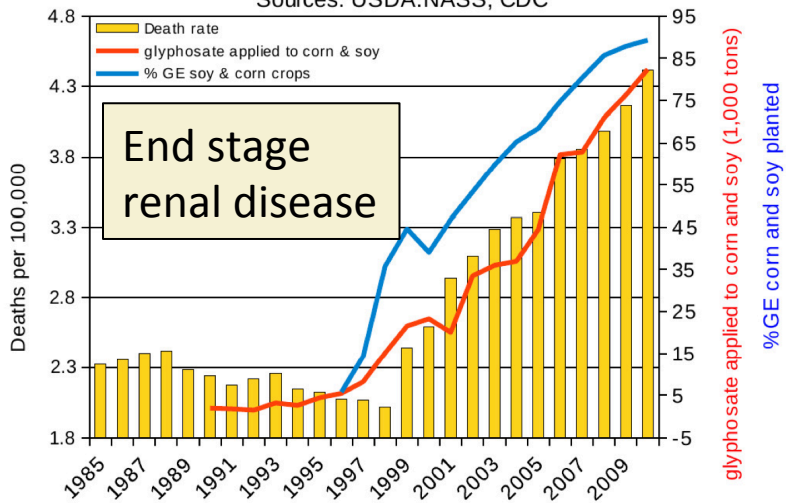
Prevalence of Diabetes in US (age adjusted)

plotted against glyphosate applied to corn & soy ($R = 0.971$, $p \leq 9.24e-09$)
 along with %GE corn & soy grown in US ($R = 0.9826$, $p \leq 5.169e-07$)
 sources: USDA:NASS; CDC



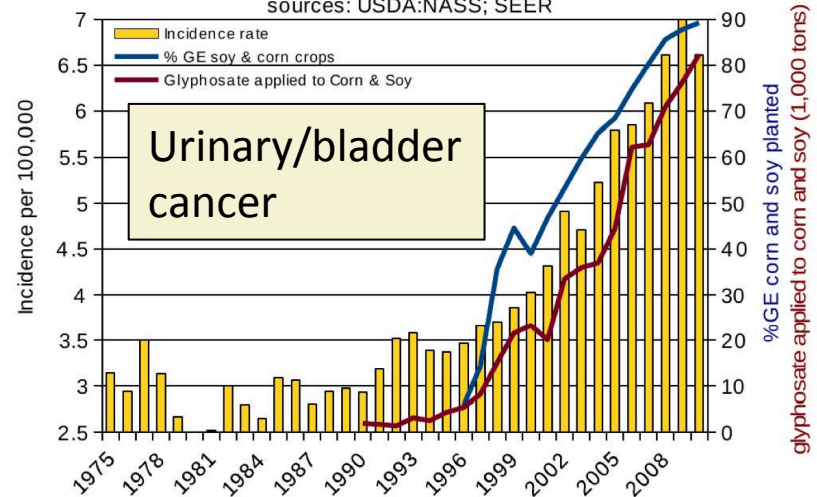
Age Adjusted End Stage Renal Disease Deaths (ICD N18.0 & 585.6)

plotted against %GE corn & soy planted ($R = 0.9578$, $p \leq 4.165e-06$)
 and glyphosate applied to corn & soy ($R = 0.9746$, $p \leq 7.244e-09$)
 Sources: USDA:NASS; CDC



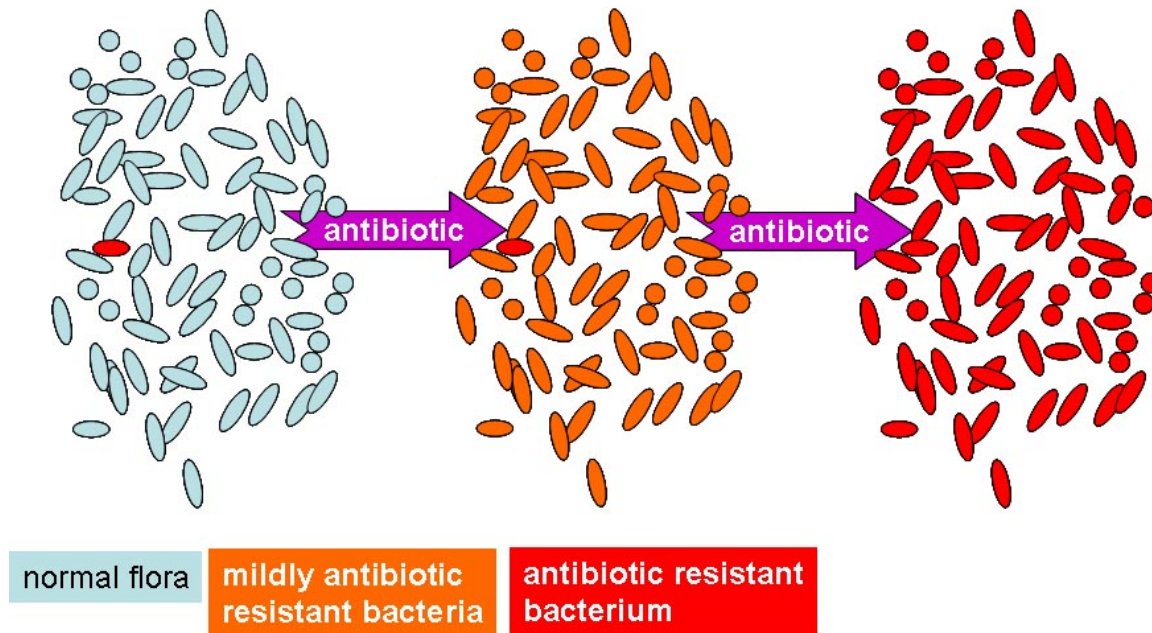
Age Adjusted Urinary/Bladder Cancer Incidence

Plotted against % GE corn and soy ($R = 0.9449$, $p \leq 7.1e-06$)
 and glyphosate applied to corn and soy ($R = 0.981$, $p \leq 4.702e-09$)
 sources: USDA:NASS; SEER



Glyphosate and Antibiotic Resistance*

- Huge and growing problem with antibiotic resistant microbes (抗生素耐藥微生物) in hospitals worldwide
- Glyphosate is a patented antimicrobial agent
- Chronic low-level exposure to one antibiotic empowers pathogens to become resistant to other antibiotics



*B Kurenbach et al., mBio March/April 2015; 6(2):e00009-15.

Manganese Dysbiosis

Paper on Glyphosate and Manganese

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Original Article

Glyphosate, pathways to modern diseases III: Manganese, neurological diseases, and associated pathologies

Anthony Samsel, Stephanie Seneff¹

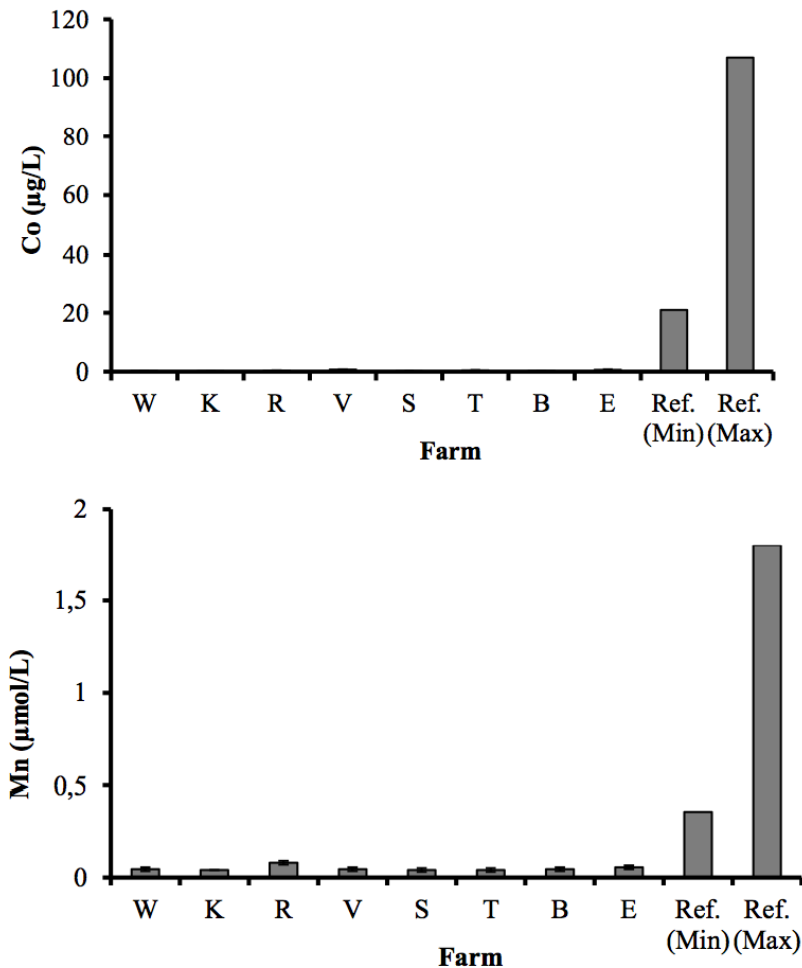
Research Scientist and Consultant, Deerfield, NH 03037, ¹Spoken Language Systems Group, Computer Science and Artificial Intelligence Laboratory, MIT, Cambridge MA 02139, USA

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*Corresponding author

Received: 22 September 14 Accepted: 21 January 15 Published: 24 March 15

Severe Deficiency in Serum Manganese and Cobalt in Cows*



Eight different farms: all cows tested had glyphosate in the urine

* M. Krüger et al., J Environ Anal Toxicol 2013, 3:5

Manganese and Autism*

- Glyphosate chelates manganese
- Manganese disruption leads to:
 - Disrupted gut bacteria → anxiety
 - Impaired dopamine (多巴胺) synthesis → thyroid disease (甲狀腺疾病)
 - Glutamate (谷氨酸) and ammonium (氨) toxicity in the brain
 - Mitochondrial damage (線粒體損傷)
 - Impaired bone development and osteoporosis (骨質疏鬆)
 - Impaired development of perineuronal nets
- Many of these pathologies are associated with autism

*A Samsel and S Seneff, Surg. Neurol. Int. 2015;6:45.

Low Manganese in Teeth Linked to Autism*

- Studied lead (鉛), mercury (汞) and manganese (錳) levels in tooth enamel of shed primary teeth in 84 children
- Manganese accumulated after birth was down by 60% in autistic children
- *No other result was statistically significant*



*MM Abdullah *et al.*, *J Autism Dev Disord.* 2012 Jun;42(6):929-36.

Low Manganese in Teeth Linked to Autism*

- Studied lead (鉛), mercury (汞) and manganese (錳) levels in tooth enamel of

Other studies have shown low serum manganese and low manganese in urine samples in association with autism

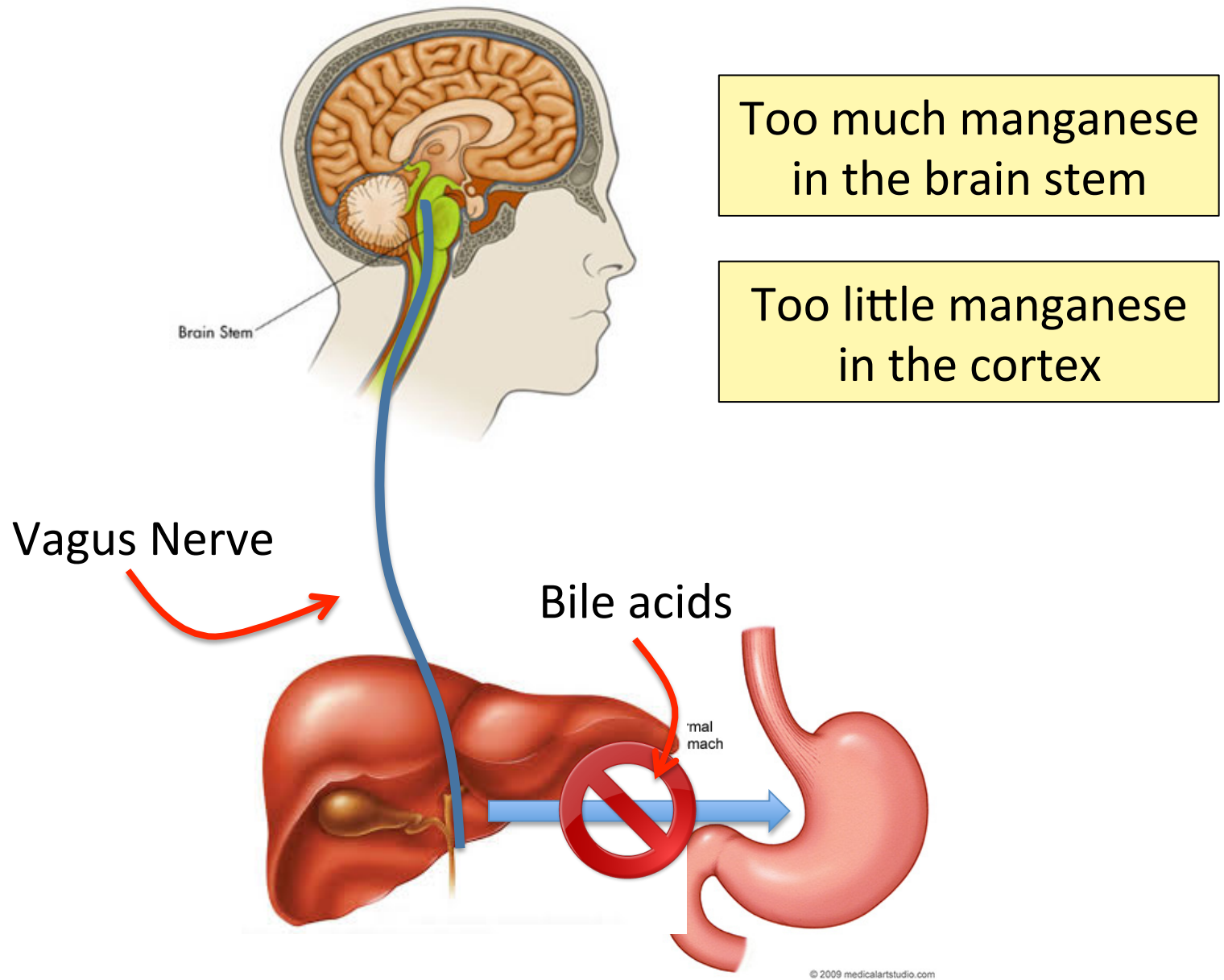
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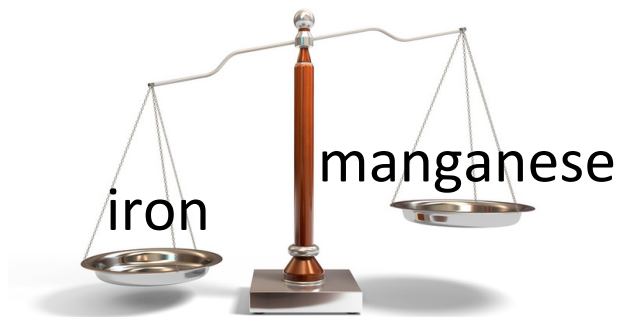


*MM Abdullah et al., *J Autism Dev Disord.* 2012 Jun;42(6):929-36.

It's not just deficiency!

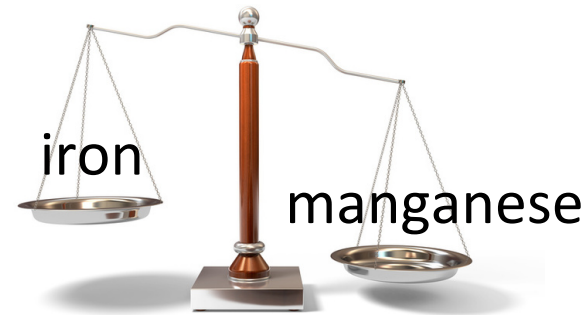


Balancing the Scales



Autism

Alzheimer's



ADHD

Parkinson's

Glyphosate disrupts the body's ability to distribute the minerals safely: Everybody walks a tight rope between deficiency and toxicity

Endocrine Disruption And Cancer

Glyphosate is an endocrine disruptor that promotes breast cancer*

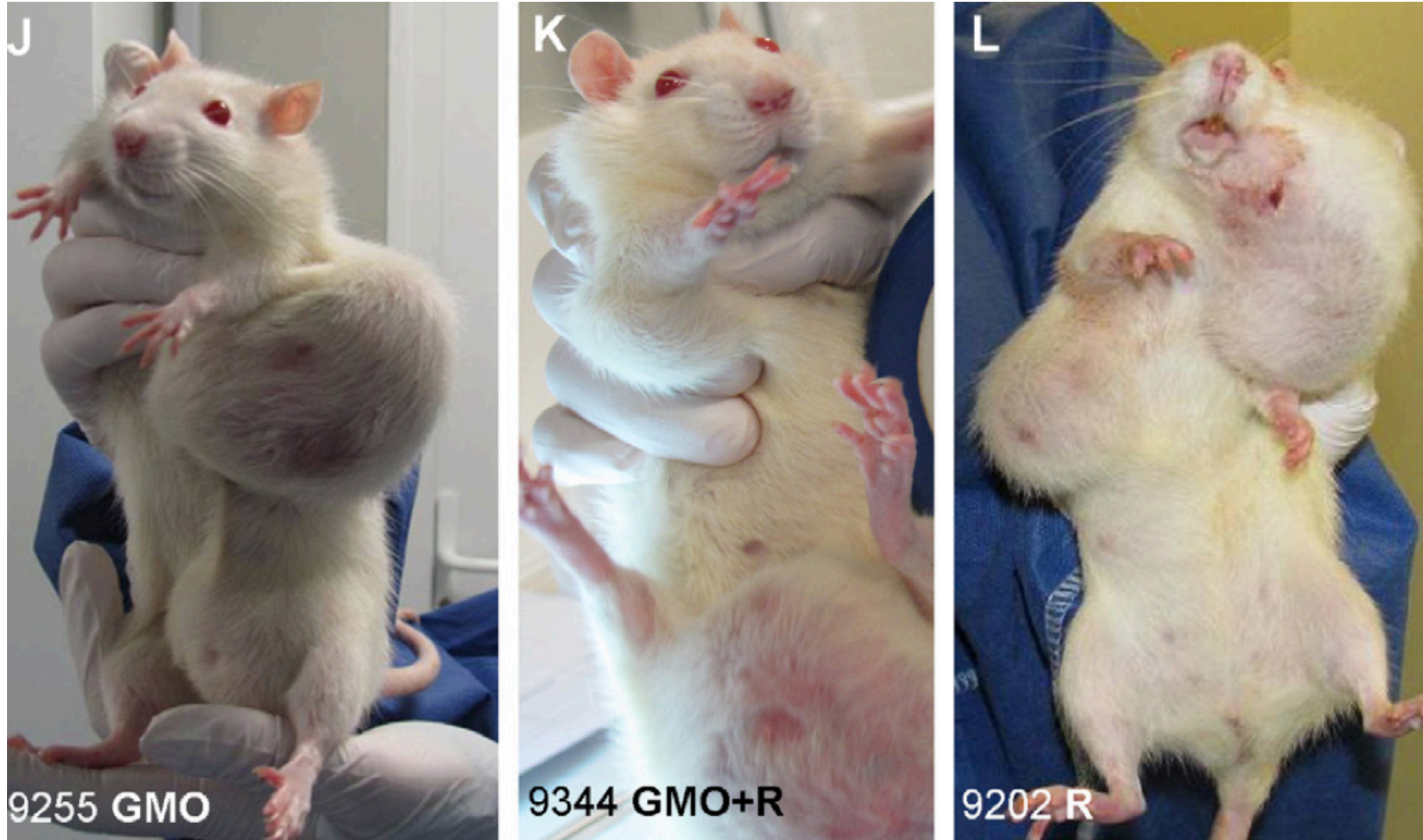
- Low and environmentally relevant concentrations of glyphosate possess estrogenic activity (雌激素)
- Glyphosate caused human hormone-dependent breast cancer cells to proliferate at concentrations of *parts per trillion*
- Additive effect from genistein, a phytoestrogen in soybeans



* S. Thongprakaisang et al., Food Chem Toxicol. 2013 Jun 8. S0278-6915(13)00363-3.

Mammary Tumors in Rats*

Rats through their entire lifespan exposed to Roundup at levels well below established safety limits



*G-E S eralini et al. Environmental Sciences Europe 2014, 26:14

Conclusions from Rat Study *

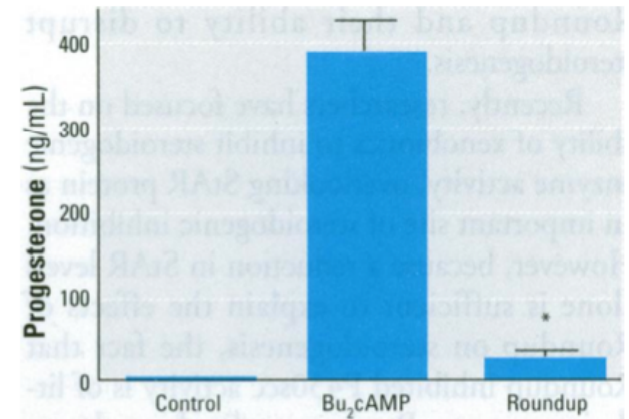
- *Female rats had greatly increased risk of mammary tumors*
- Males had significantly increased risk of tumors of the liver and kidney
- Sex hormone disruption for both males and females
- Enhanced oxidative stress
- Very significant kidney dysfunction
- *Effects didn't become apparent until after 4 months*



*G-E Séralini et al. Environmental Sciences Europe 2014, 26:14

Roundup Disrupts Steroid Synthesis*

- StAR protein mediates rate-limiting step in steroid synthesis
- Roundup suppresses StAR protein by 90% and reduces steroidogenesis by 94%
- This affects both the production of sex hormones in the gonads and the production of cortisol (皮質醇) and aldosterone (醛固酮) in the adrenal glands

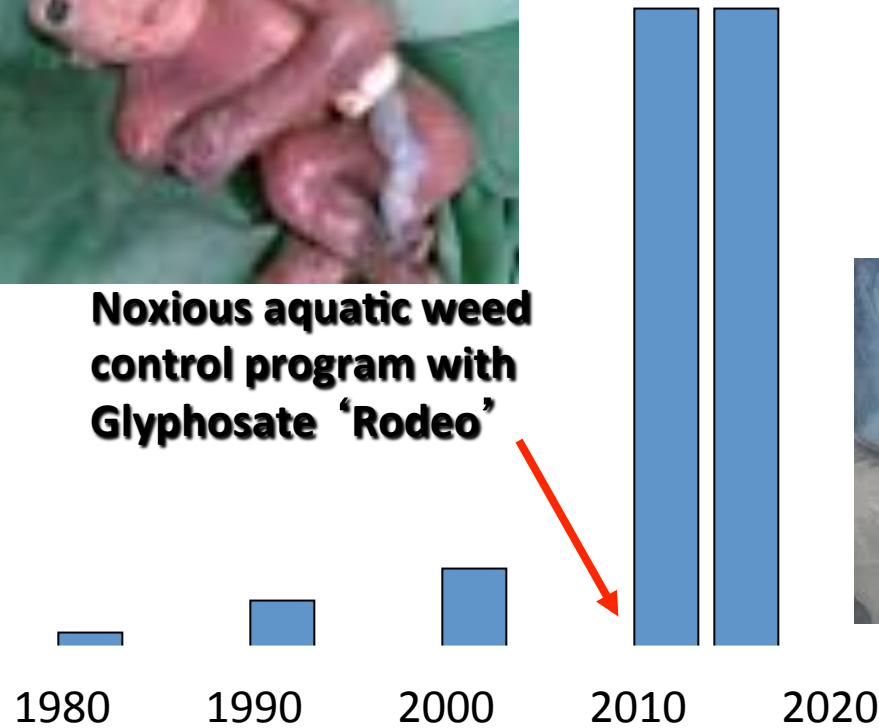


*L.P. Walsh et al., Environmental Health Perspectives 108(8), 2000 769-776.

“Glyphosate, Brain Damaged Babies in Yakima Valley”*



Noxious aquatic weed control program with Glyphosate ‘Rodeo’



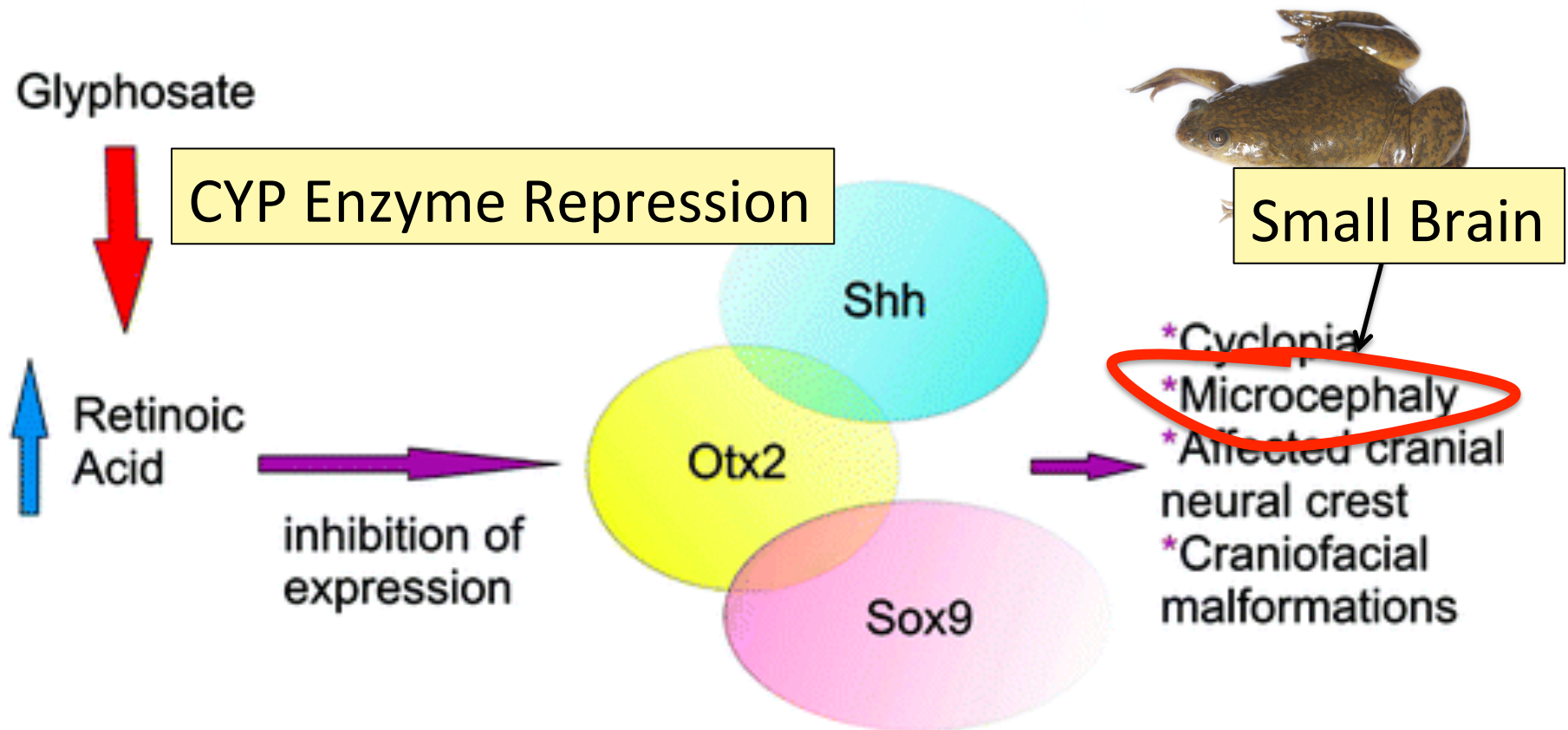
“Glyphosate, Three Rivers, and Anencephaly”

Yakima Harold Republic

Slide thanks to Prof. Don Huber, with permission

*Farm Wars 3/6/14

Glyphosate Upregulates Retinoic Acid*



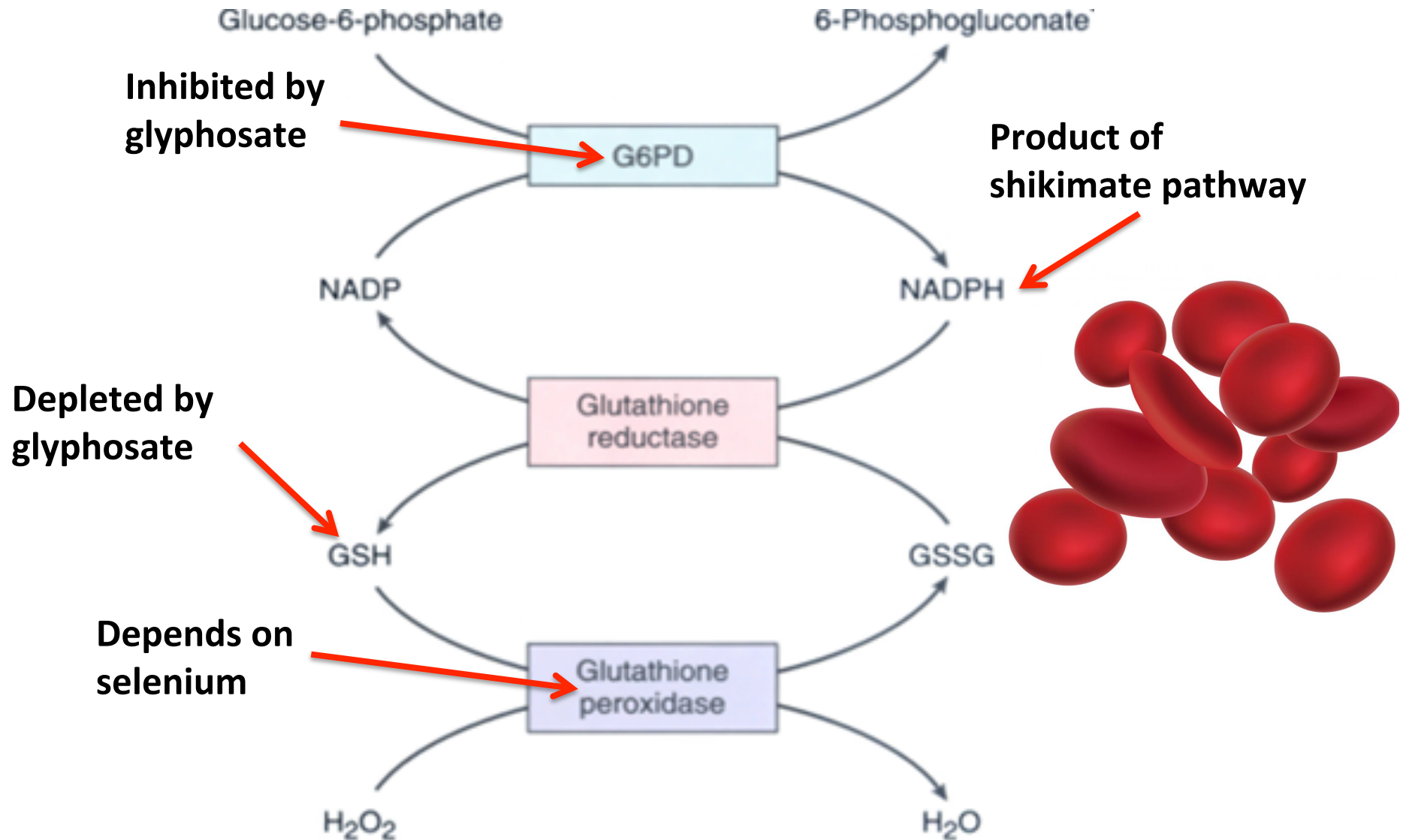
*A. Carrasco, Teratogenesis by glyphosate based herbicides and other pesticides. Relationship with the retinoic acid pathway. In Breckling, B. & Verhoeven, R. (2013) GM-Crop Cultivation – Ecological Effects on a Landscape Scale. Theorie in der Ökologie 17. Frankfurt, Peter Lang.

Anemia and Vitamin D Deficiency

Glyphosate: the Central Mechanisms

- Glyphosate acts as an antibiotic (抗生素) to disrupt gut bacteria, leading to overgrowth of pathogens
- Disruption of liver CYP enzymes leads to impaired bile flow (膽汁流量) and low vitamin D
 - This disrupts sulfate synthesis and transport
 - Also impairs detoxification of other toxic chemicals
- Damage to red blood cells leads to anemia and toxicity due to free iron
 - Hypoxia ensues → low grade encephalopathy (腦病)
- Manganese, aluminum and glutamate become toxic to the brain

This Detoxification Scheme is Essential in Red Blood Cells



This Detoxification Scheme is Essential in Red Blood Cells

Glucose-6-phosphate

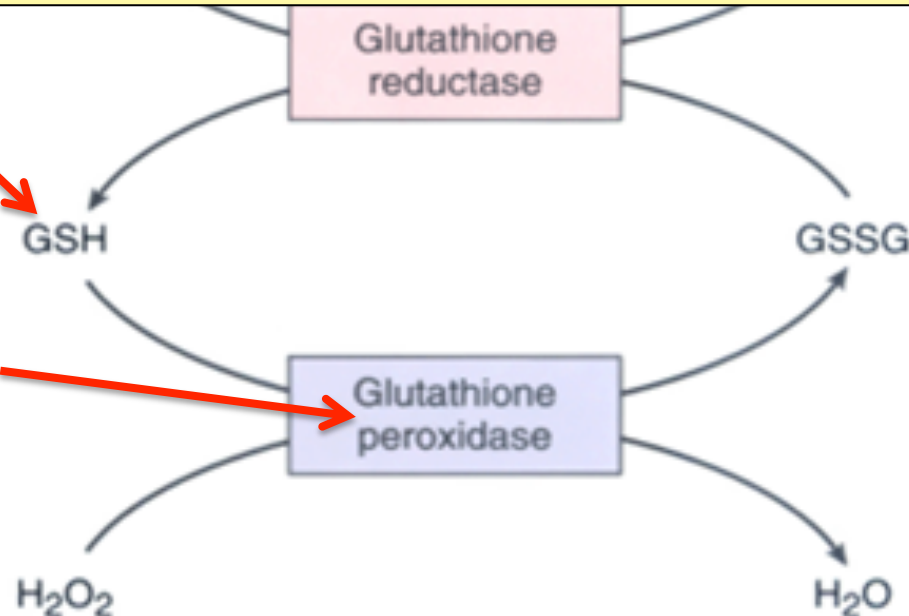
6-Phosphogluconate

Inhibited by

G6PD Deficiency Leads to Hemolysis (溶血) and Anemia (貧血)

Depleted by glyphosate

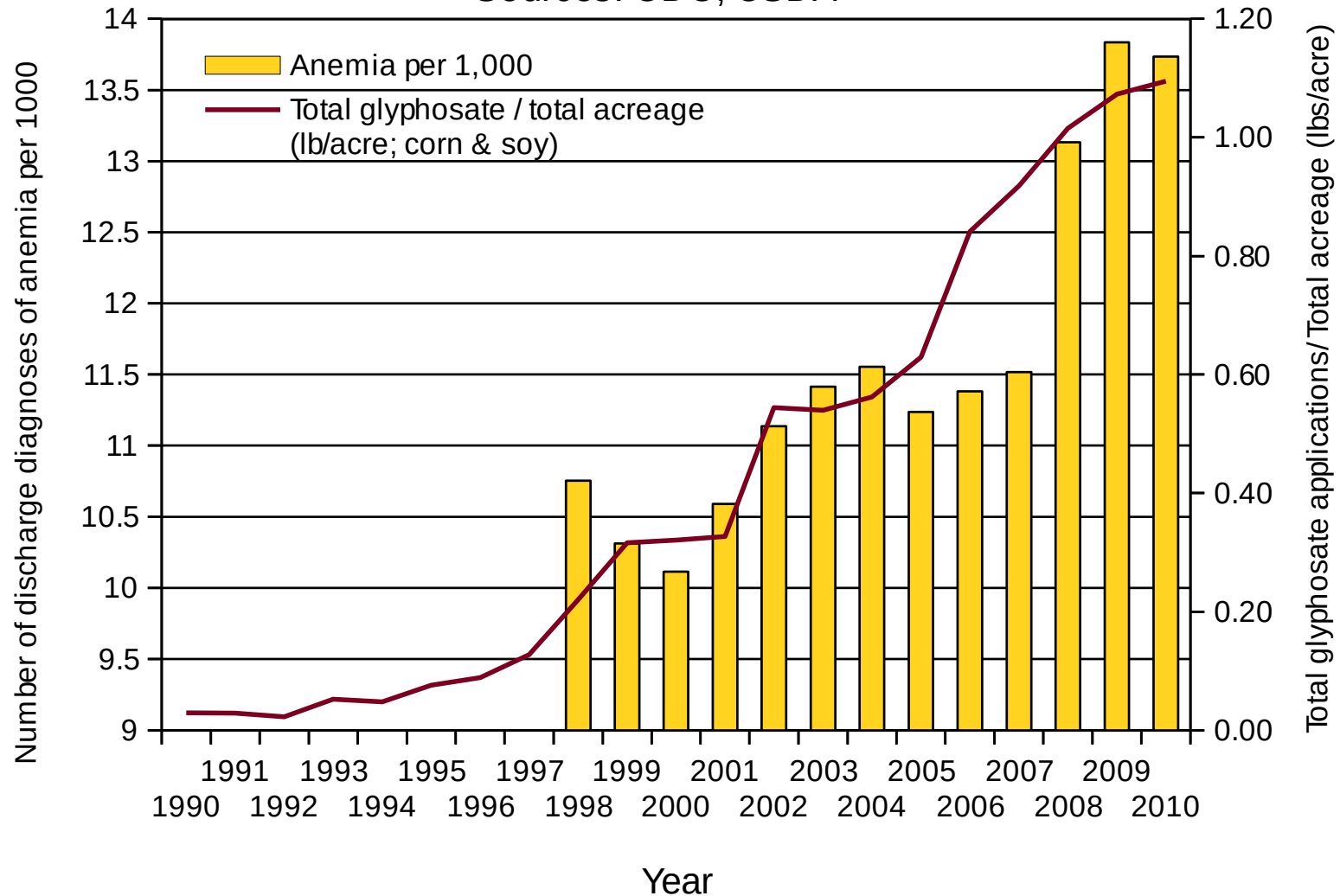
Depends on selenium



Hospital Discharge Diagnoses of Anemia (ICD 280-85) & Glyphosate applied to corn & soy crops

$R = 0.8952, p \leq 0.00018$

Sources: CDC; USDA



Plot produced in collaboration with Dr. Nancy Swanson from US Government data

Anemia leads to low oxygen which induces chronic low grade encephalopathy linked to autism

Entropy **2013**, *15*, 372-406; doi:10.3390/e15010372

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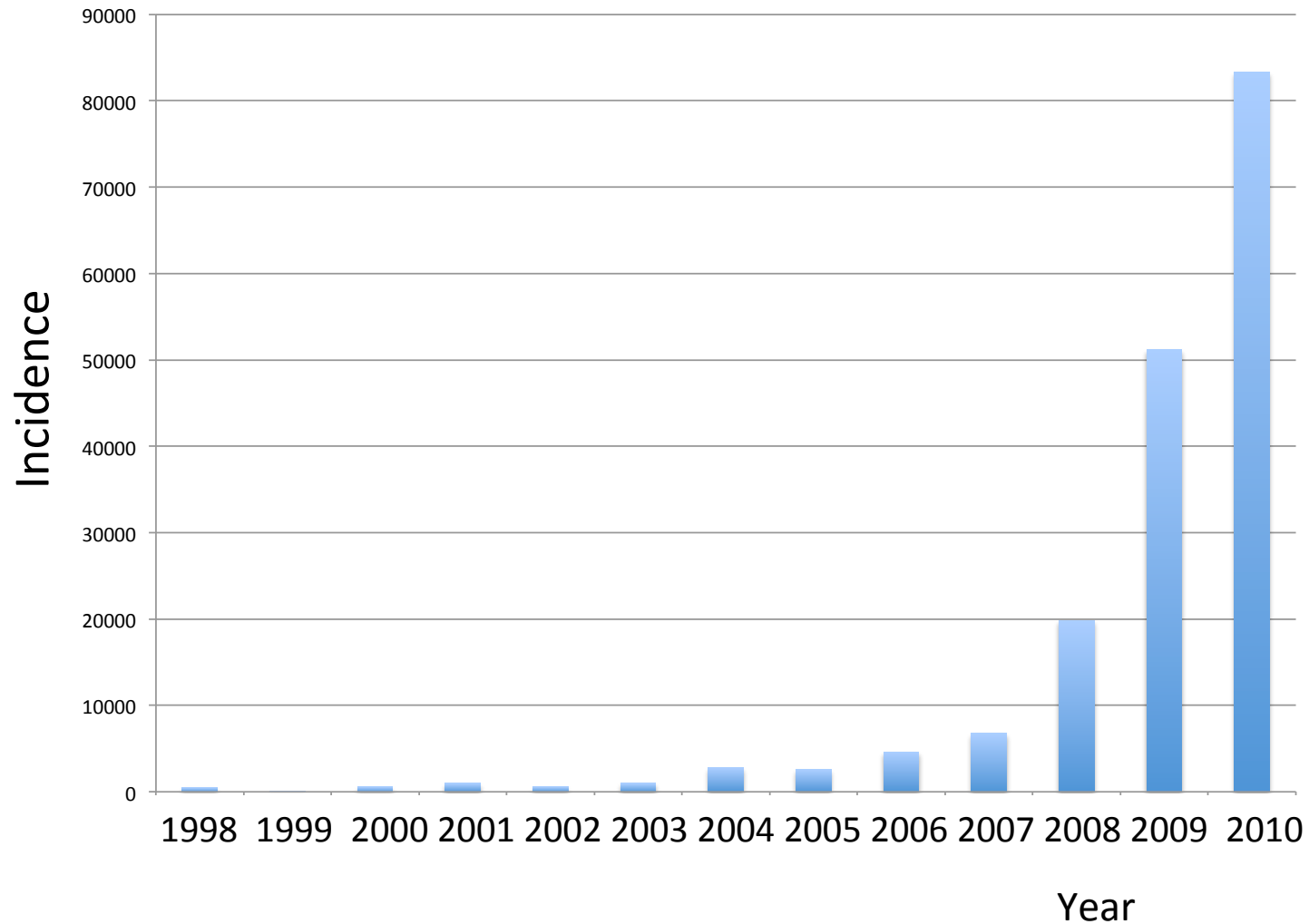
www.mdpi.com/journal/entropy

Review

Is Encephalopathy a Mechanism to Renew Sulfate in Autism?

Stephanie Seneff ^{1,*}, Ann Lauritzen ², Robert M. Davidson ³ and Laurie Lentz-Marino ⁴

Vitamin D Deficiency Epidemic in the United States

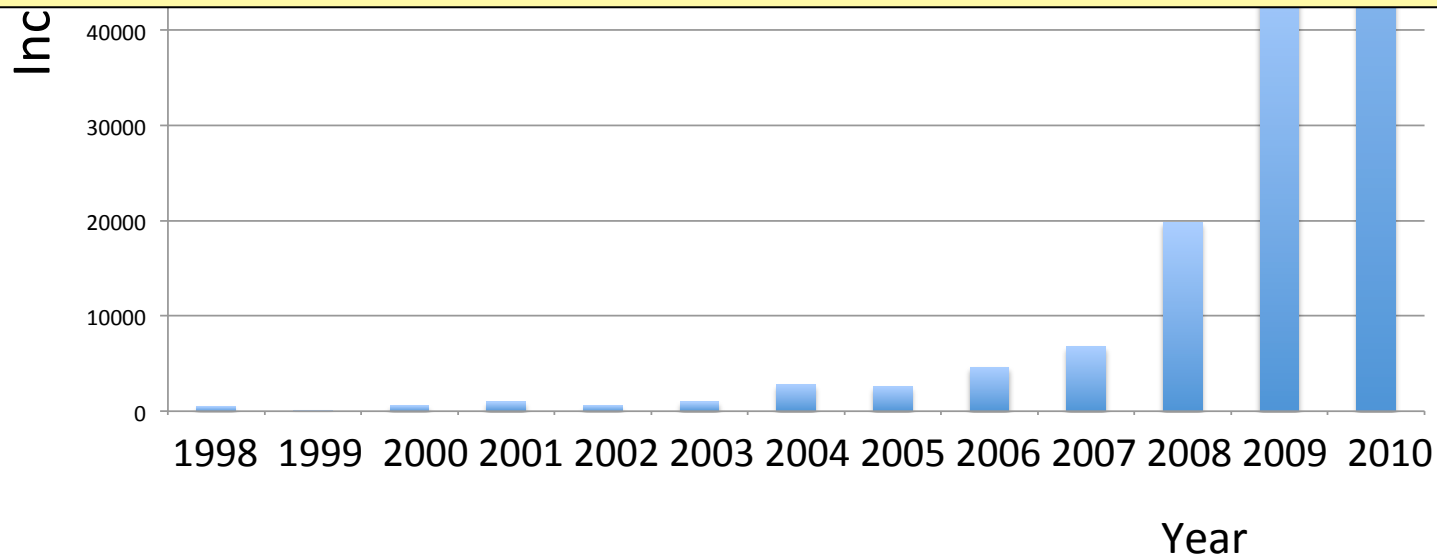


Hospital Discharge Data from the US CDC

Vitamin D Deficiency Epidemic in the United States



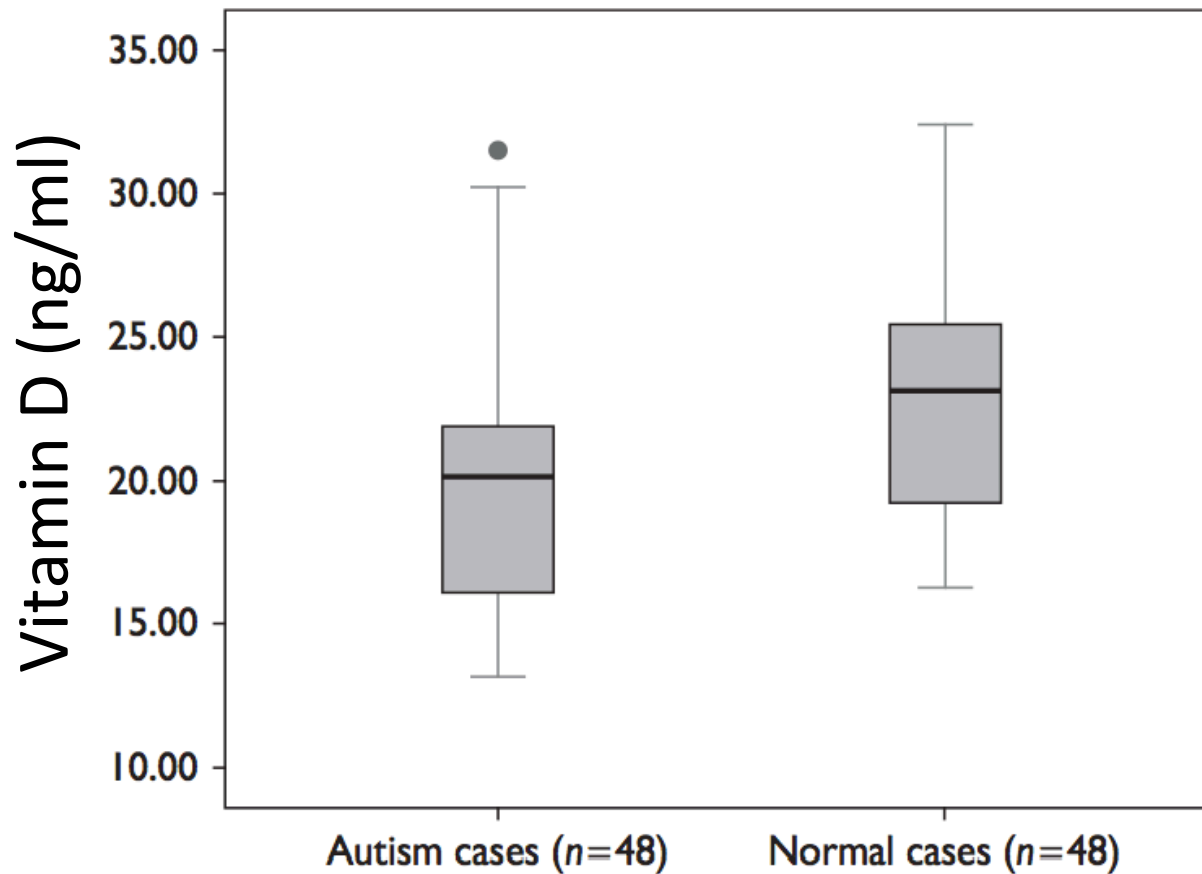
Vitamin D is activated by Cytochrome P450 enzymes
in the liver



Hospital Discharge Data from the US CDC

Recent Study from China*

Fig. 1



*Z-L Gong et al., NeuroReport 2014, 25:23–27

**Many Animal Species
under Stress**

Where Have all the Insects Gone?

“The nine-spotted beetle commonly made her home on *farmlands* for the rich source of insects these regions provided.”



“Until the *mid-1970s*, the nine-spotted beetle was one of the most common ladybug beetles”



*<http://animals.pawnation.com/causes-decline-ninespotted-beetle-6492.html>

Monarch Butterfly Collapse*



“.. farmers have switched in droves to new varieties of crops that are genetically

engineered to tolerate *the most widely used weed killer in the United States*. The resulting use of weed killers has wiped out much of the milkweed that once grew between crop rows and on buffer strips separating fields and roads.”

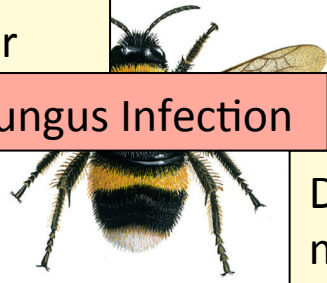
*M. Wines, New York Times, Dec. 20, 2013.

nytimes.com/2013/12/21/us/setting-the-table-for-a-fluttering-comeback-with-milkweed.html

We Should be Alarmed!*

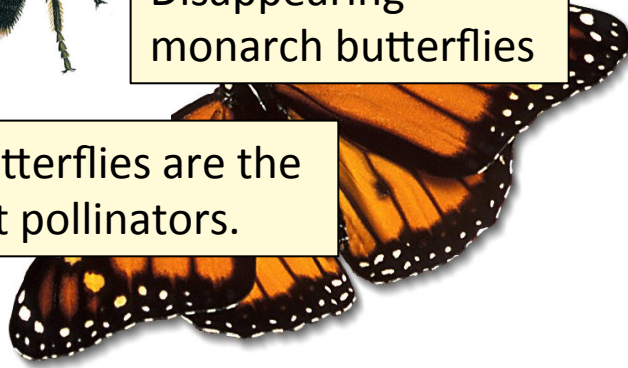
Bee Colony
Collapse
Disorder

Fungus Infection



Disappearing
monarch butterflies

After bees, butterflies are the
second largest pollinators.



Dissolving starfish

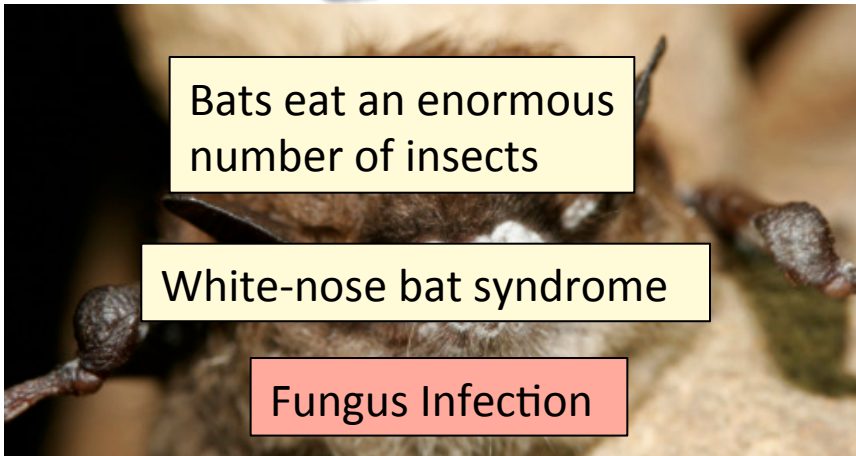
Fungus Infection



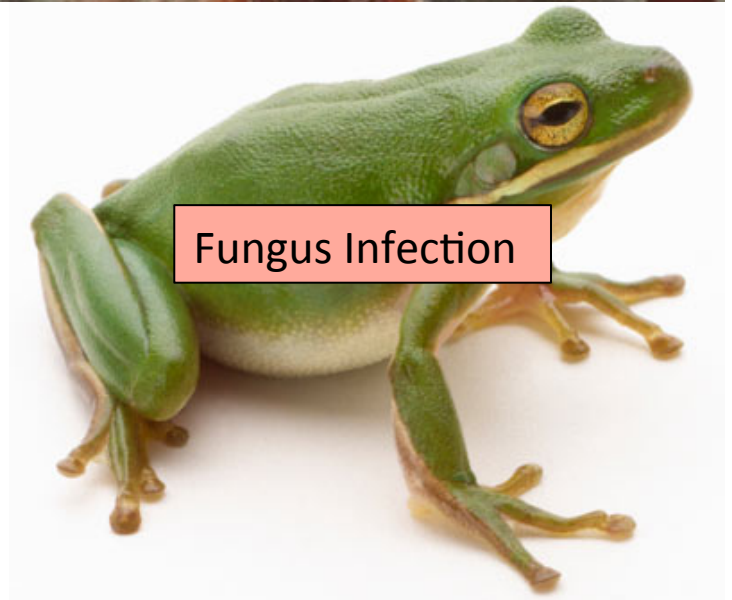
Bats eat an enormous
number of insects

White-nose bat syndrome

Fungus Infection



Fungus Infection



*R. Mason et al., Journal of Environmental Immunology and Toxicology 1:1, 3-12; 2013

Roundup herbicide enhances the growth of aflatoxin-producing fungi*

- Fungus (菌) is a growing threat in GMO Roundup-Ready corn
- Research consistent with studies on other fungal strains such as Fusarium, Rust fungi and Blight fungi



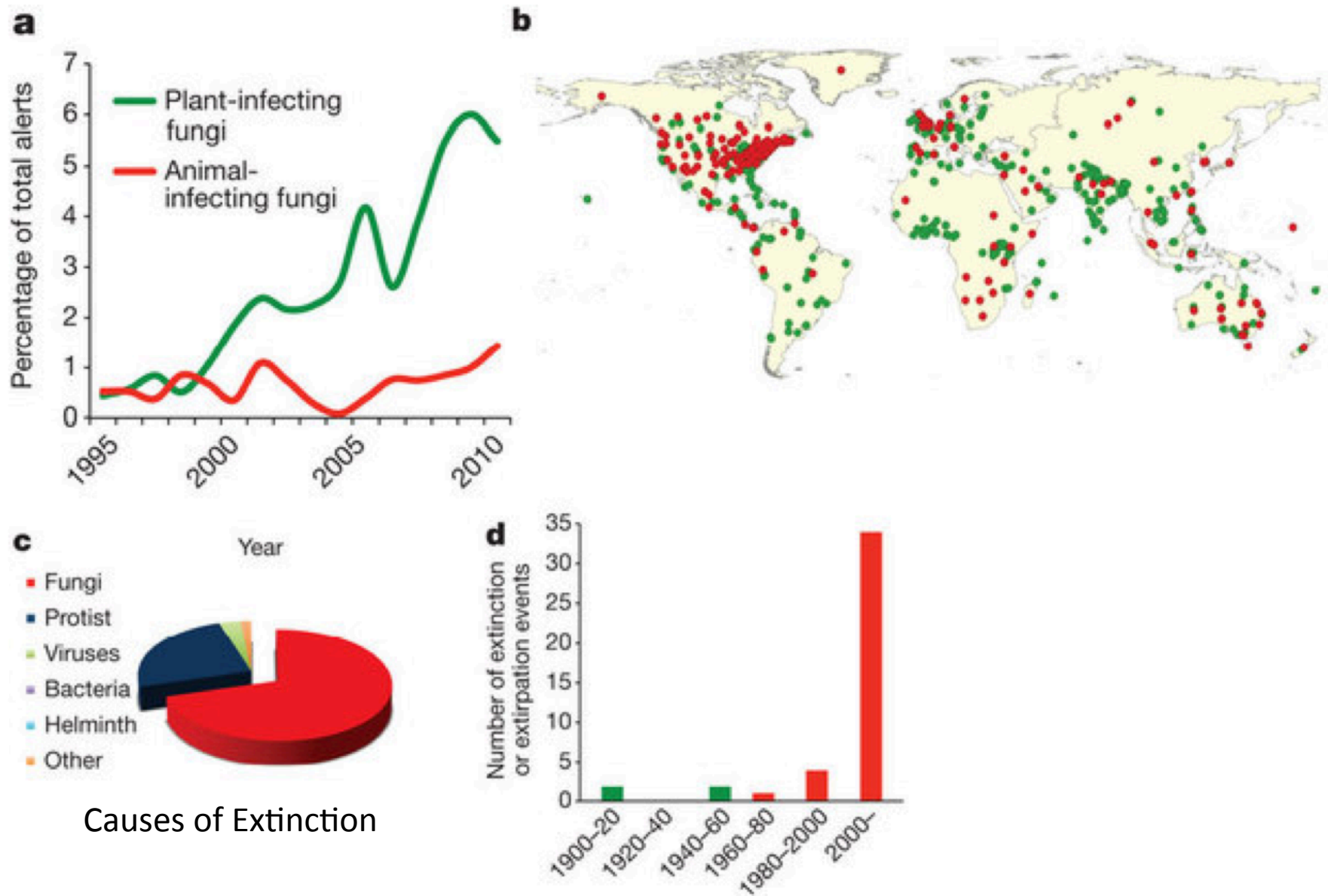
*Barberis et al., Journal of Environmental Science and Health, Part B: Pesticides, Food Contaminants, and Agricultural Wastes. 2013, 48(12), 1070-1079.

“Emerging fungal threats to animal, plant and ecosystem health”*

“The past two decades have seen an increasing number of virulent infectious diseases in natural populations and managed landscapes. In both animals and plants, an unprecedented number of fungal and fungal-like diseases have recently caused some of the most severe die-offs and extinctions (滅絕) ever witnessed in wild species, and are jeopardizing food security.”

*M.C. Fisher et al., Nature Reviews 484(7393), 186-194.

Figure 1, Nature Reviews Paper*



*M.C. Fisher et al., Nature Reviews 484(7393), 186-194.

Bee Colony Collapse Syndrome

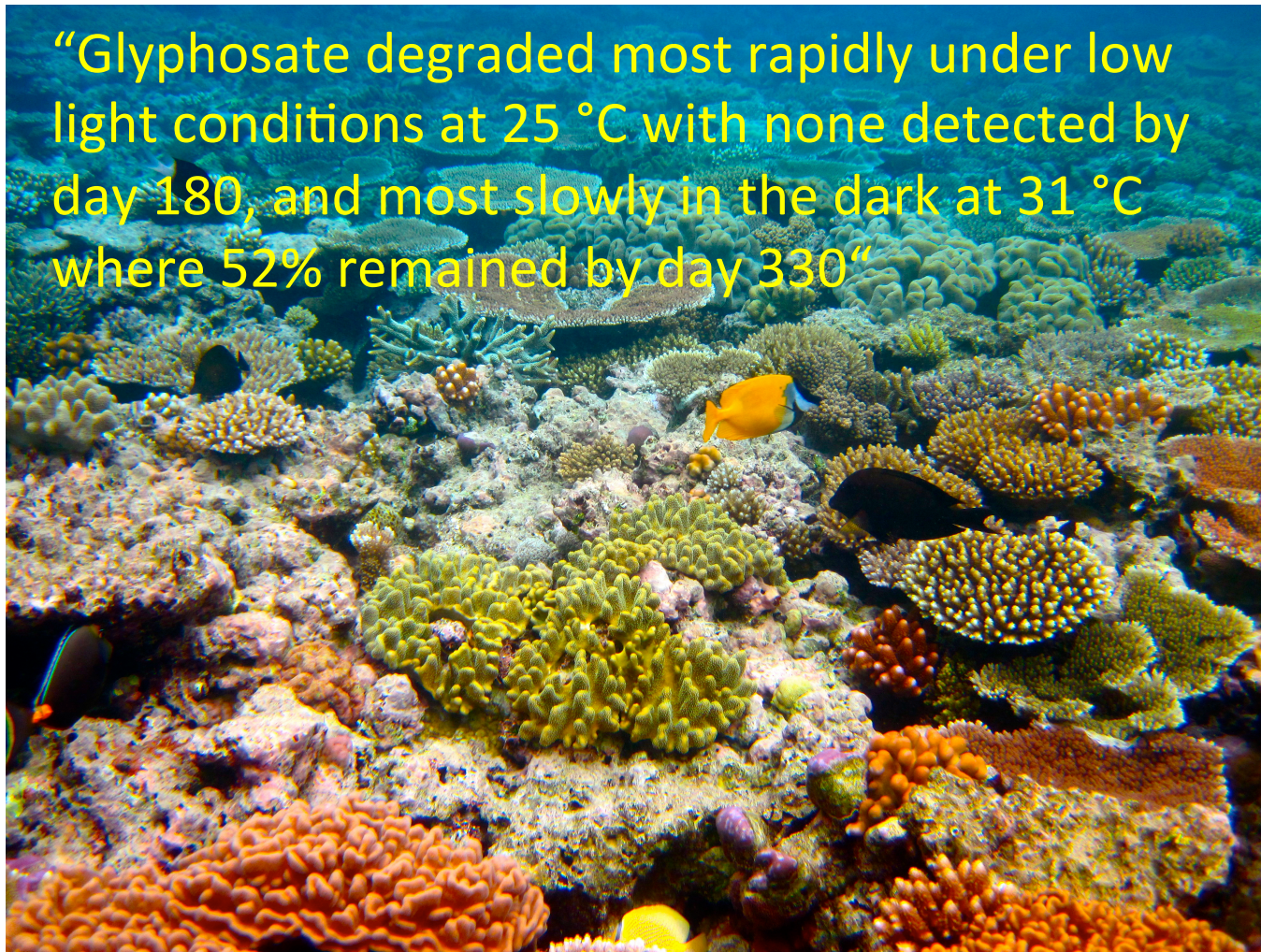
- Bees are exposed to many insecticides from pollen – e.g., Chlorpyrifos (neonicotinoid)
- Their resistance to neonicotinoids depends on CYP enzymes
- Honey bees have fewer CYP enzymes than other insects*
- These enzymes are disrupted by glyphosate



Disruption of CYP enzymes in the liver would impair humans' ability to detoxify many environmental toxicants: synergistic effect

*Claudianos et al., Insect Molecular Biology (2006) 15(5), 615–636.

“Glyphosate persistence in seawater”*



“Glyphosate degraded most rapidly under low light conditions at 25 °C with none detected by day 180, and most slowly in the dark at 31 °C where 52% remained by day 330”

*P. Mercurio *et al.*, *Marine Pollution Bulletin* 2014;85(2):385-390.

Extracts from Common Plants Can Treat Glyphosate Poisoning*

- Roundup is toxic to hepatic (肝) and embryonic cells (胚胎幹細胞) at doses far below those used in agriculture and at residue levels present in some GM food.
- Extracts from common plants such as dandelions, barberry, and burdock can protect from damage, especially if administered prior to exposure.



*C Gasnier et al. Journal of Occupational Medicine and Toxicology 2011, 6:3

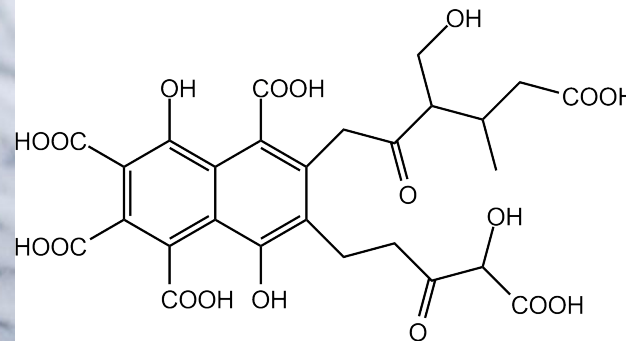
Treating Glyphosate Poisoning in Animals (e.g., cows) *



Activated charcoal (活性炭), bentonite clay (粘土), humic and fulvic acids, and sauerkraut juice (酸菜) have been shown to be effective in reducing urinary levels of glyphosate and improving animal health



Bentonite Clay



Fulvic Acid



Activated Charcoal

*H Gerlach et al., J Environ Anal Toxicol 2014, 5:2

:Organic Food is the Solution



Summary

- Contrary to Monsanto's claims, glyphosate is toxic to humans
- Mechanism involves disrupted gut microbes, chelation of metals, inhibition of CYP enzymes in the liver, damage to red blood cells, etc.
- Glyphosate is likely the main cause of the autism epidemic in America and the rising health care costs
- Glyphosate is also causing harm to many animal species on land and in the sea
- Best advice I can give is to eat only organic food