5. Glyphosate: The Elephant in the Room

Stephanie Seneff

Wise Traditions Workshop

November 8, 2013

people.csail.mit.edu/seneff/WAPF_Slides_2013/5_glyphosate.pdf

Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has.

-- Margaret Mead

US anthropologist (1901 - 1978)

Introduction

Outline

- Autism Epidemic
- Gut Microbes & Digestive Disorders
- Some Statistics
- Endocrine Disruption, Cancer and Kidney Failure
- Glyphosate and Sulfate
- Evidence of Exposure
- Summary

“One of the puzzling aspects of autism is the marked increase in the incidence of autism that began in the United States in the early 1980s and has appeared to increase continuously since then.”

-William Shaw, Journal of Restorative Medicine 2013; 2: First line of Introduction.

Some Conditions Associated with Autism

- Disrupted gut bacteria
- Depleted serotonin supply
- Deficiency in sulfur metabolites

Is there a toxic substance that is currently on the rise in our environment that could account for these comorbidities?

Recent Publication

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

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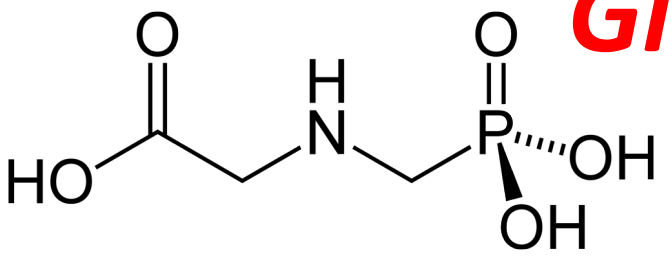
Abstract: Glyphosate, the active ingredient in Roundup®, is the most popular herbicide used worldwide. The industry asserts it is minimally toxic to humans, but here we argue otherwise. Residues are found in the main foods of the Western diet, comprised primarily



Glyphosate!!

- Glyphosate is now the #1 herbicide in use in the U.S. and is increasingly used around the world
  - Developed and patented by Monsanto in the 1970's
  - Came out from under patent in 2000
  - Inhibits an enzyme in the *shikimate pathway* involved in synthesis of tyrosine, tryptophan and phenylalanine (the three *aromatic amino acids*)
- Huge expansion of GMO corn, soy, cotton, sugar beet and canola crops has led to sharp increases in glyphosate usage in the last decade

Is Glyphosate Nontoxic?

- Monsanto has argued that glyphosate is harmless to humans because we don't have the shikimate pathway
- However, our gut bacteria *DO* have this pathway
  - We depend upon them to supply us with essential amino acids (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

Glyphosate: Some Biological Effects*

- Depletes aromatic amino acids and methionine
- Disrupts gut bacteria
  - Studies with chickens, cows and pigs show overgrowth of pathogens in gut
- Disrupts cytochrome P450 (CYP) enzymes which are involved in many biological functions
- Depletes important minerals
  - Calcium, manganese, zinc, cobalt, iron, ….
- Likely impairs sulfate synthesis and sulfate transport

* A. Samsel and S. Seneff, Entropy 2013, 15, 1416-1463

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Glyphosate: Some Biological Effects (cont'd)

- Depletes aromatic amino acids and methionine

  Tryptophan → serotonin → melatonin

  – Serotonin deficiency is linked to obesity, autism, Alzheimer's disease, depression, and violent behavior
  – Melatonin controls sleep/wake cycle

  Tyrosine → dopamine, adrenaline, and melanin

  – Dopamine deficiency leads to Parkinson's disease
  – Melanin in skin protects from UV exposure
  – Methionine is an essential sulfur-containing amino acid

- Disrupts cytochrome P450 (CYP) enzymes which are involved in:
  – Regulation of sterols like vitamin D, cholesterol, and sex hormones
  – Bile acid production
  – Detoxifying environmental toxins
  – Stabilizing blood (hemorrhaging vs blood clots)

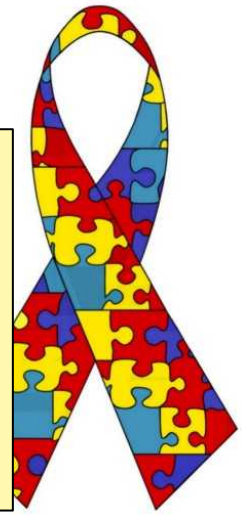
Some Biomarkers for Autism

- Disrupted gut bacteria; inflammatory bowel
- Low serum sulfate
- Methionine deficiency
- Serotonin and melatonin deficiency
- Defective aromatase (CYP enzyme)
- Zinc and iron deficiency
- High serum nitrate and ammonia
- Impaired immune function
- Chronic low-grade inflammation in the brain

Some Biomarkers for Autism

- Disrupted gut bacteria; inflammatory bowel
- Low serum sulfate

These can all be explained by glyphosate's known effects on biological systems



- High serum nitrate and ammonia
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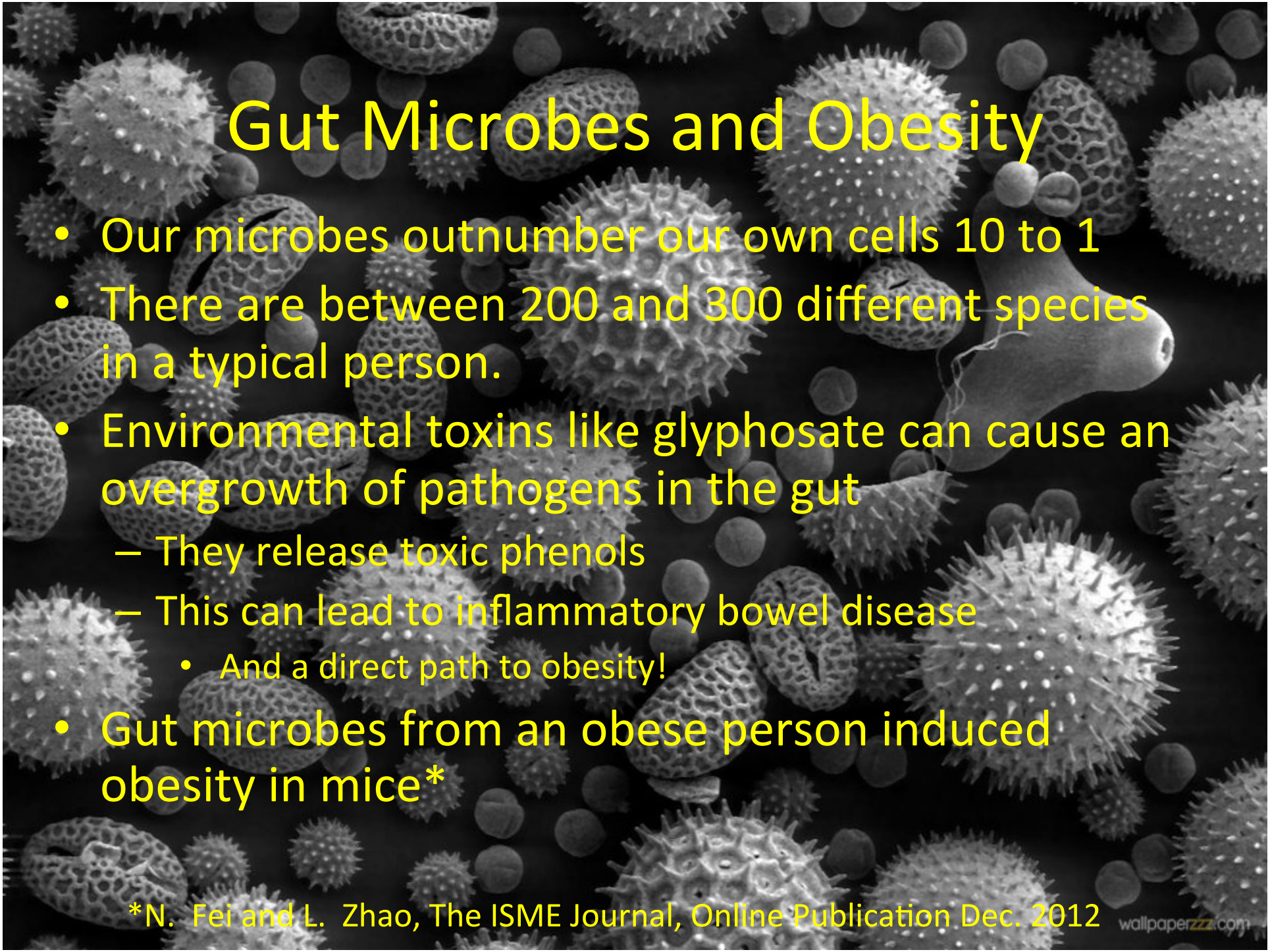
- Chronic low-grade inflammation in the brain

Recapitulation

- Autism rates have been increasing at an alarming rate in recent years, in step with increases in glyphosate application to GMO crops
- Autism is associated with disrupted gut bacteria, serotonin deficiency, impaired immune function, sulfate deficiency, etc.
- Most of the biomarkers associated with autism can be explained by known biological effects of glyphosate
- These effects can also explain many other modern diseases and conditions

Gut Microbes & Digestive Disorders



Gut Microbes and Obesity

- Our microbes outnumber our own cells 10 to 1
- There are between 200 and 300 different species in a typical person.
- Environmental toxins like glyphosate can cause an overgrowth of pathogens in the gut
  - They release toxic phenols
  - This can lead to inflammatory bowel disease
    - And a direct path to obesity!
- Gut microbes from an obese person induced obesity in mice*

*N. Fei and L. Zhao, The ISME Journal, Online Publication Dec. 2012

Pigs Fed GMOs Develop Inflamed Gut*

- Pigs have a similar digestive system to humans
- Digestive problems observed anecdotally in GMO-fed pigs
  - inflammation in stomach and intestine, stomach ulcers, thinning of intestinal walls, increase in haemorrhagic bowel disease

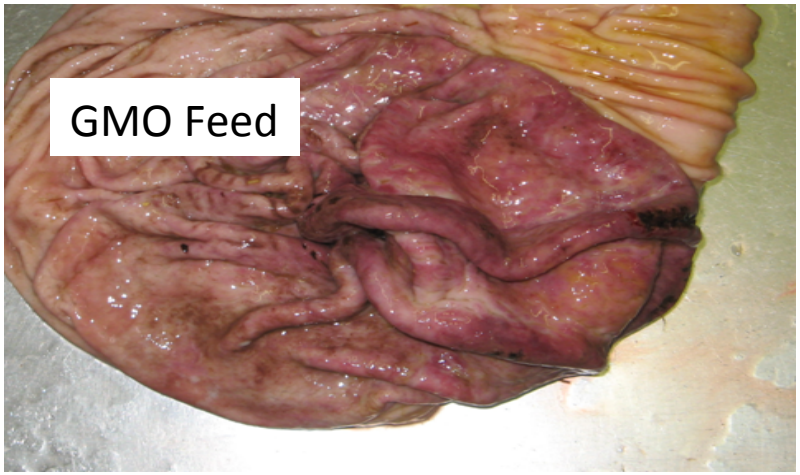
Follow-on Experiment:

- 168 just-weaned pigs fed "typical diet," soy and corn, until slaughtered
  - Half fed GMO versions, half organic.

*J.A. Carman et al., Journal of Organic Systems, 8(1), 2013.

Pigs Fed GMOs Develop Inflamed Gut*

- Blind autopsies conducted
  - Female pigs' uterus 25% larger in GMO-fed pigs
  - Female pigs 2.2x more likely to get severe stomach inflammation on GMO diet
  - Males were 4x more likely



Photos kindly provided by Howard Vlieger

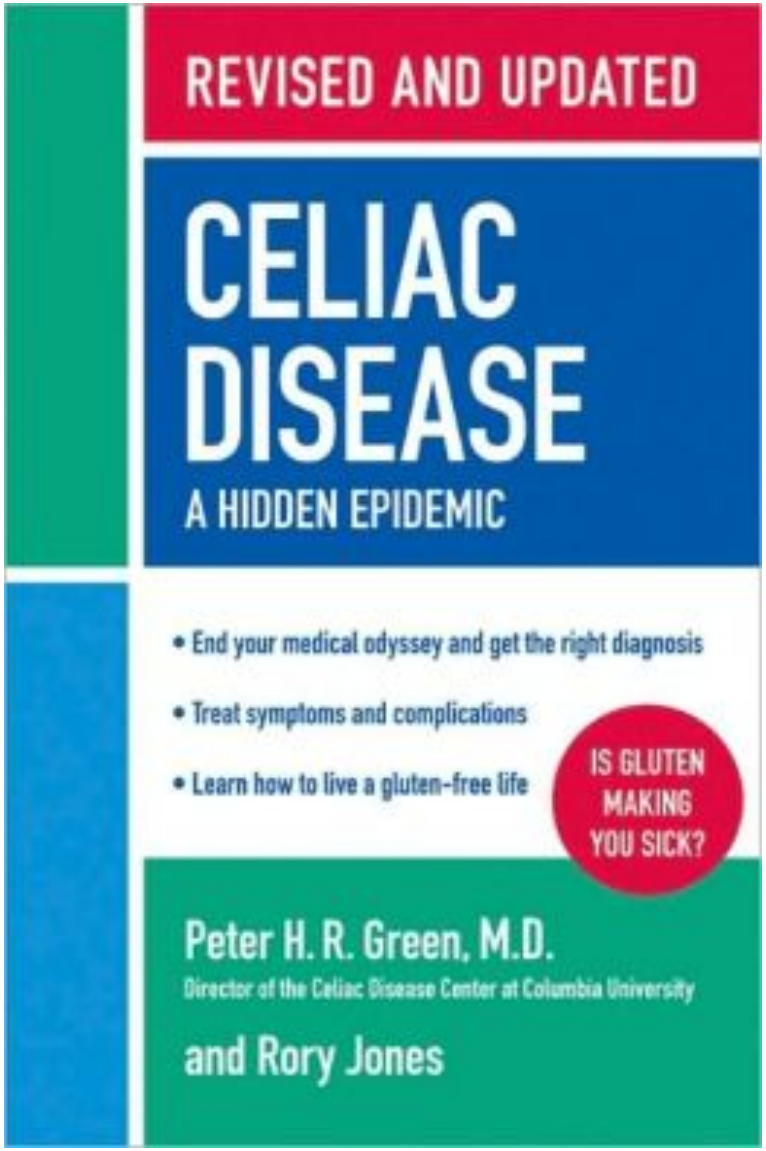
*J.A. Carman et al., *Journal of Organic Systems*, 8(1), 2013.

Human Digestive System Disorders

- We are seeing an alarming increase in the US in many diseases related to the gut
  - Crohn's disease, inflammatory bowel disease, colitis, acid reflux disease, gluten and casein intolerance, celiac disease, leaky gut
- The gut-brain axis links neurological disorders with gut disorders
- I believe that glyphosate is a major cause


CHECK OUT
OUR NEW
GLUTEN
FREE
AISLE!

Celiac Disease has Quadrupled in the US in the Last 50 Years



Celiac Disease, Glyphosate and Non-Hodgkin's Lymphoma

- Bifidobacteria are depleted in celiac disease*
  - They convert gluten to less toxic form
- Glyphosate preferentially kills bifidobacteria**
- Celiac disease is associated with increased risk to non-Hodgkin's lymphoma***
- Glyphosate itself is also linked directly to non-Hodgkin's lymphoma****

*M. Velasquez-Manoff, NY Times Sunday Review, Feb. 23, 2013

**A.A. Shehata et al., Curr Microbiol. 2013 Apr;66(4):350-8.

.*** C. Catassi et all, JAMA. 2002 Mar 20;287(11):1413-9.

****M. Eriksson et al., Int J Cancer. 2008 Oct 1;123(7):1657-63.

"Herbicide Resistant Ryegrass Troubling for Wheat Growers"*

"If you see ryegrass at harvest following an Axial XL application, it may be resistant. And you can scatter seed all over the field with the combine."

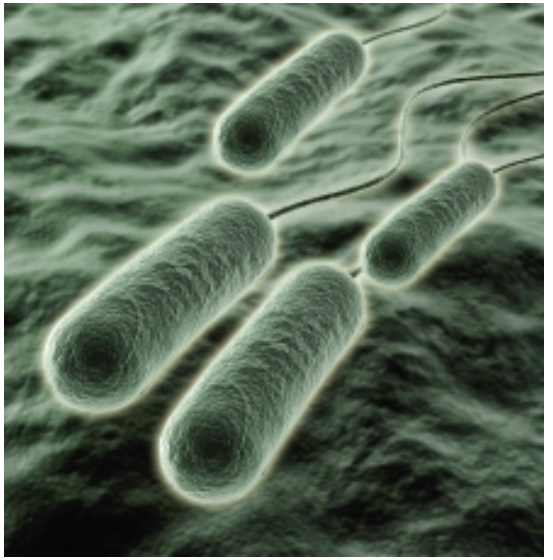
"A reduced-tillage approach, using a *burndown herbicide* ahead of planting in a stale seedbed, also holds promise for improved control."

" 'We may be able to knock out 80% to 90% of the resistant ryegrass with glyphosate.' "

-- Jim Swart, integrated pest management specialist

*Ron Smith, Western Farm Press, Mar. 23, 2013

Pseudomonas and Glyphosate*



- Pseudomonas aeruginosa, a gram negative bacterium, is a major problem today in hospitals due to its resistance to multiple antibiotics
- P. aeruginosa is one of only three bacterial species that can break down glyphosate.
  - It produces formaldehyde as a by-product
  - Formaldehyde is a well established neurotoxin

*S. de Betnzmann and P. Plésiat Environ Microbiol. 2011 Jul;13(7):1655-65.

"Dramatic Increase in Hospitalization of US Children With Inflammatory Bowel Disease"*

- Study conducted at Case Western Reserve University School of Medicine
- > 11 Million hospitalization records examined
- Patients < 20 years old
  - 49% increase from 2000 to 2009 in Crohn's disease discharges
  - 71% increase in ulcerative colitis discharges

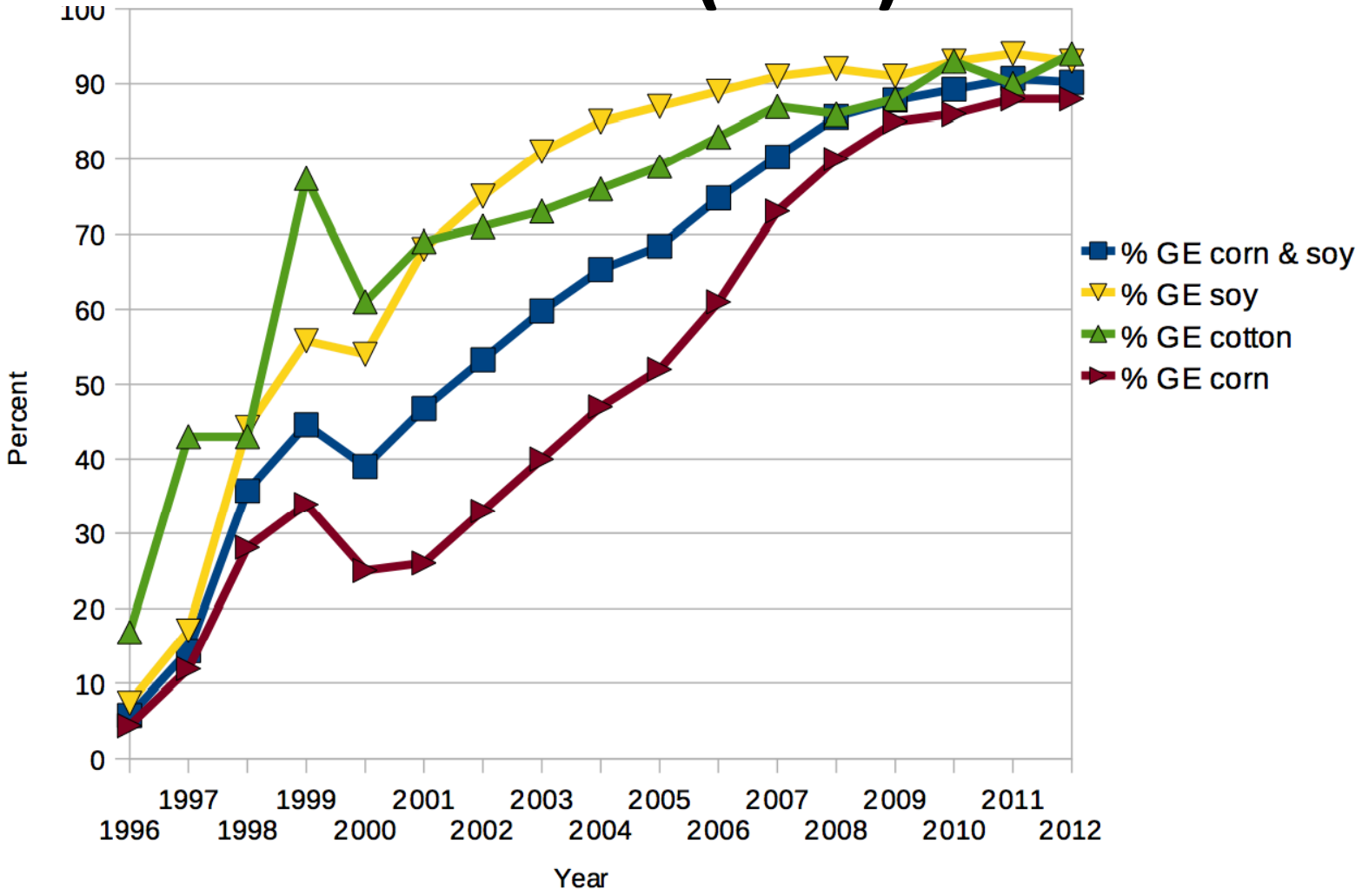
*C. Pant et al., Journal of Investigative Medicine 61(6), August 2013. Science Daily, June 25, 2013

Recapitulation

- We depend on our gut bacteria in many ways
  - Bacteria from an obese person can induce obesity in mice
- Glyphosate is an antibiotic that preferentially kills the good bacteria
  - Pigs fed GMO corn and soy develop inflammatory gut
  - Humans are experiencing an epidemic in gut disorders like inflammatory bowel disease and gluten intolerance
  - Due to herbicide-resistant rye grass, farmers use glyphosate as a desiccant at harvest time
- Pseudomonas aeruginosa, a growing problem in hospitals, can break down glyphosate

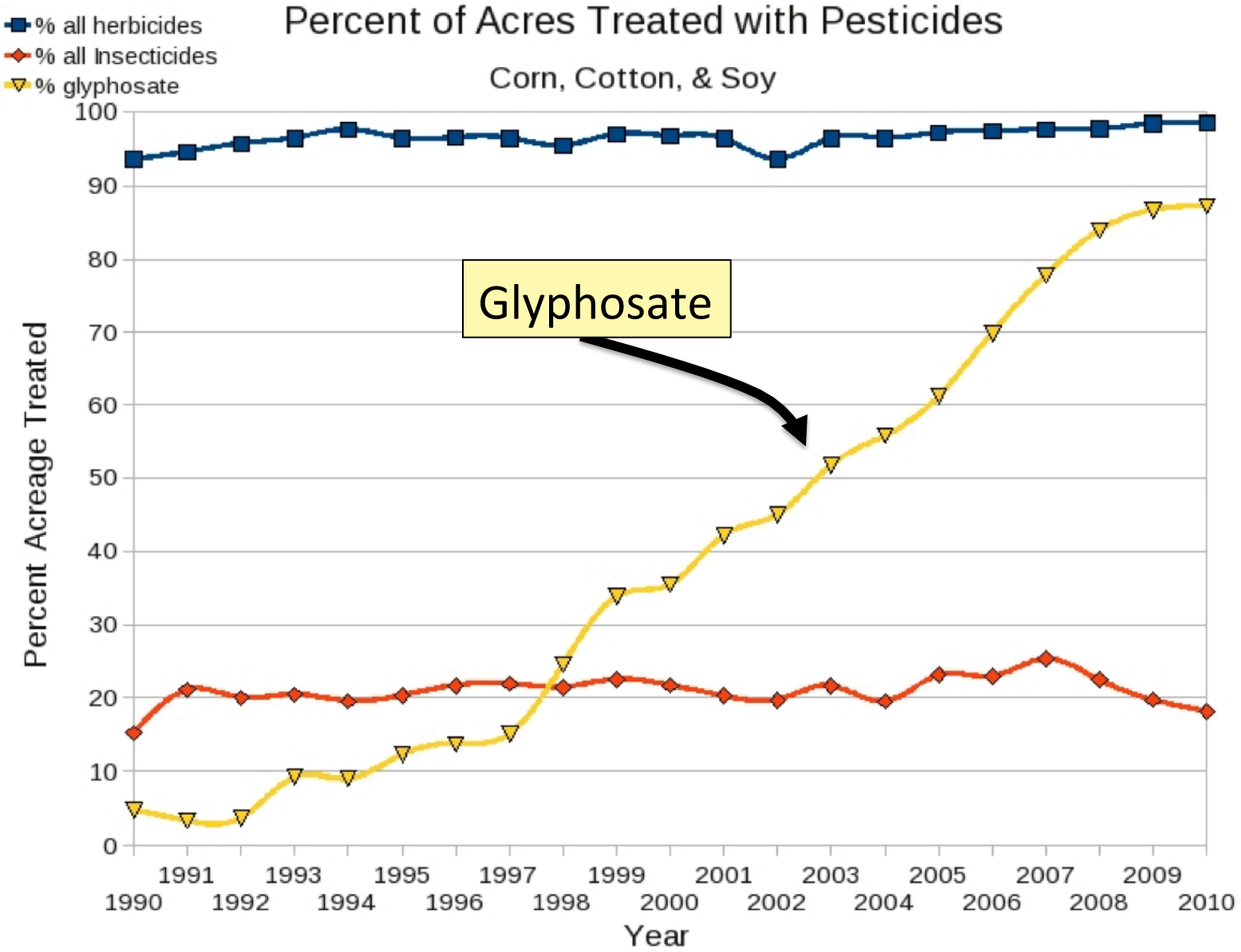
Some Statistics

Tremendous Growth in GE Crops in Last 15 Years (U.S.)



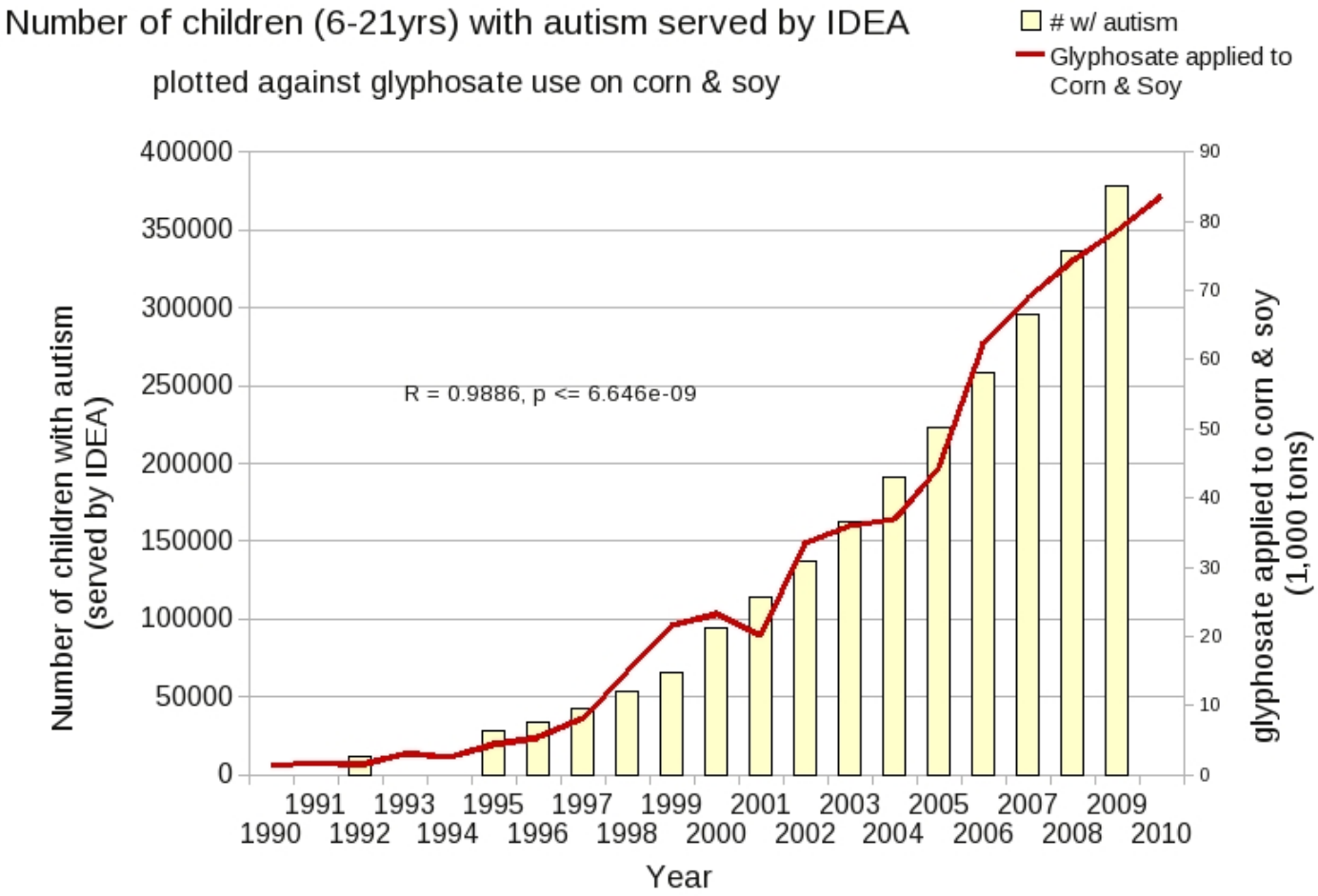
1996-1999 data: USDA Agricultural Economic Report No. (AER-810) 67 pp, May 2002
2000-2012 data: USDA:NASS National Agricultural Statistics Service

Glyphosate vs. Other Pesticides*



*http://sustainablepulse.com/wp-content/uploads/GMO-health.pdf

Glyphosate and Autism*



Pearson Correlation Coefficient = 0.99

*Nancy Swanson, http://www.examiner.com/article/data-show-correlations-between-increase-neurological-diseases-and-gmos

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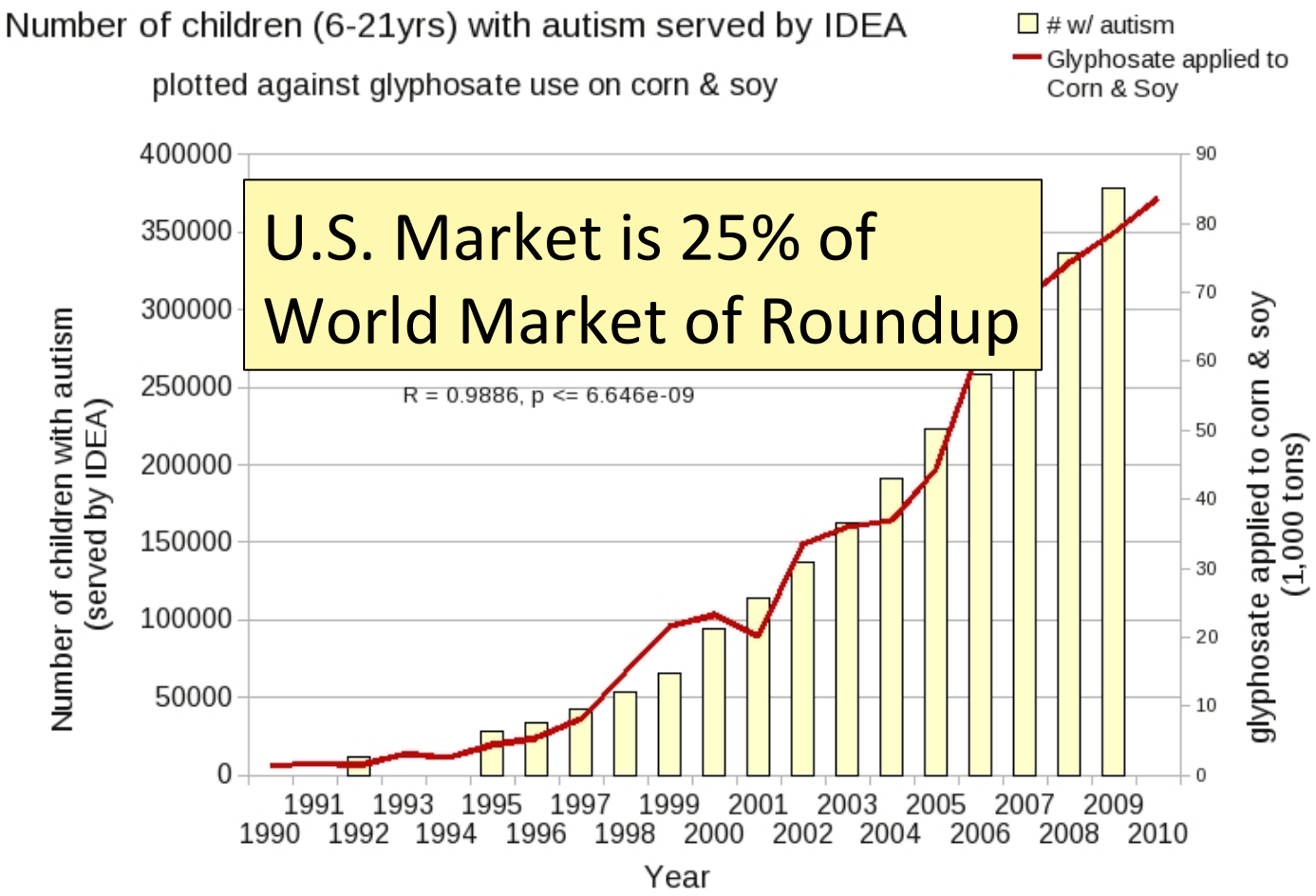

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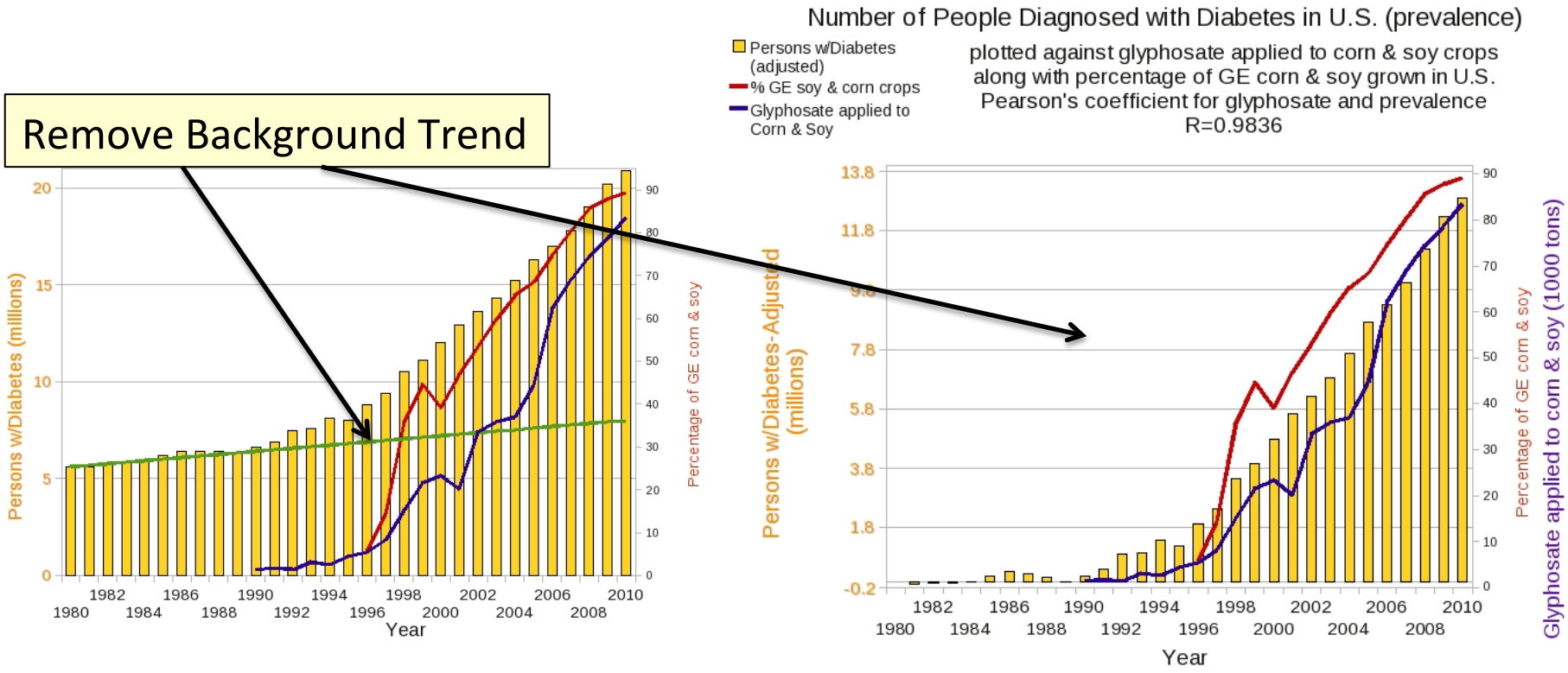
Diabetes and Roundup Application*



*Nancy Swanson, http://www.examiner.com/article/data-show-correlations-between-increase-neurological-diseases-and-gmos

Nancy Swanson's Data: Pearson Correlation Coefficients between Diseases and Roundup Application to Corn and Soy Crops in the US*

	Correlation	P-value
Obesity	0.9698	0.000000976
Diabetes (prevalence)	0.9818	≤ 4.44E-009
Diabetes (incidence)	0.9643	≤ 1.42E-008
End Stage Renal Disease (incidence)	0.8991	≤ 5.45E-007
End Stage Renal Disease (prevalence)	0.9520	≤ 3.05E+008
Autism (prevalence)	0.9886	6.65E-009
Alzheimer's (deaths)	0.9271	≤ 1.29E-007
Parkinson's (deaths)	0.8953	≤ 6.52E-007
Dementia (deaths)	0.9908	≤ 6.31E-009

*Nancy Swanson, http://www.examiner.com/article/data-show-correlations-between-increase-neurological-diseases-and-gmos

Is Glyphosate Making Us Obese?

Obesity in US over Time*

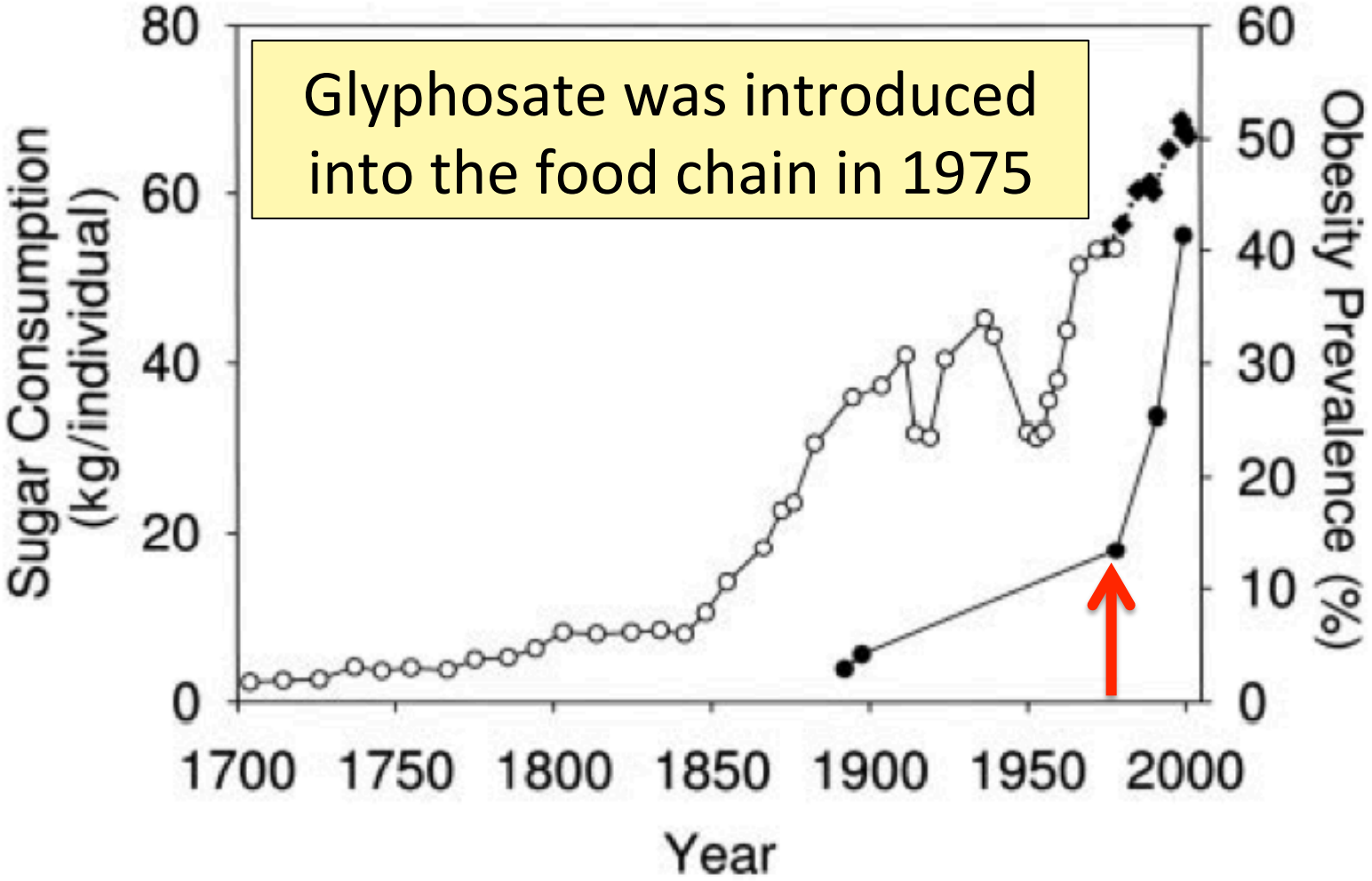


*Figure 1 in R.J. Johnson et al., Am J Clin Nutr 2007;86:899–906.

Recapitulation

- We have seen a tremendous growth in GMO crops in the last 15 years along with a tremendous increase in glyphosate application
- Use of Roundup on corn and soy over time correlates very strongly with the observed increases in a host of diseases:
  - Diabetes, obesity, autism, kidney failure, Alzheimer's disease, Parkinson's disease, etc.
- Obesity epidemic in US began when Roundup was first introduced in 1975

Endocrine Disruption, Cancer and Kidney Failure

"More and more studies have revealed carcinogenic and endocrine disrupting effects of Roundup at lower doses than those authorized for residues found in Genetically Modified Organisms."

-- Dr. Nancy Swanson

Glyphosate is an endocrine disruptor that promotes breast cancer*

- Low and environmentally relevant concentrations of glyphosate possess estrogenic activity

- 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.

Glyphosate and Anencephaly*

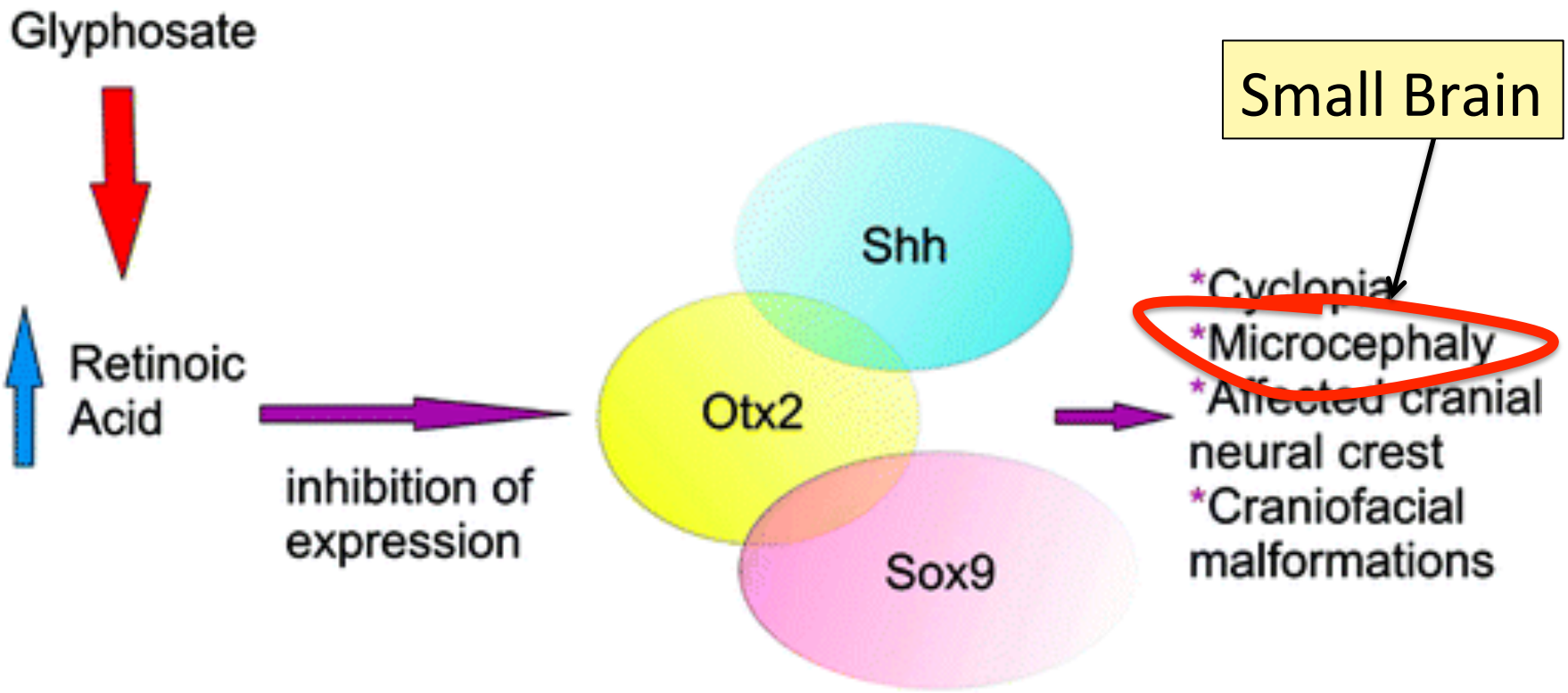
- Yakima, Benton and Franklin counties in Washington State have an unusually high number of pregnancies affected by the birth defect, anencephaly
- 75 pesticides were analyzed in studying contamination due to surrounding agriculture
  - 47 (63%) of these were detected
  - Glyphosate was applied in large amounts, but *was not studied*

- 5% solution of glyphosate was also used heavily around irrigation ditches to control weeds
  - Main herbicide recommended due to its "low toxicity"

Glyphosate has been linked to anencephaly due to its effect on retinoic acid

*__Barbara H. Peterson__. __Farm Wars__, http://farmwars.info/?p=11137

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.

Fertility Rates are Dropping Worldwide*

- Fertility rates are falling rapidly in countries around the world, often to below 2.0.
  - Cultural changes play a role
  - But glyphosate is likely contributing as well
- Sperm depend on cholesterol sulfate for decapitation and fertilization
- Cholesterol sulfate synthesis depends on cytochrome P450 (CYP) enzymes
- Glyphosate disrupts CYP enzyme function

*A. Samsel and S. Seneff, Entropy 2013, 15, 1416-1463.

"Male fertility under threat as average sperm counts drop"*

- Study of 26,600 men in France found sperm concentration had decreased by 32% since the 1990s.
- Numbers steadily dropped by 2% per year from 1989 to 2005.
- Proportion of normally formed sperm also declined by about 1/3.

* M. Rolland et al., Hum Reprod. 2013 Feb;28(2):462-70.

Kidney Failure in Agricultural Workers*

- Workers in sugarcane fields in Central America and in India are dying at a young age in record numbers from kidney failure
- Arsenic exposure from drinking water?
- Excess use of Tylenol?

Glyphosate disrupts the enzyme that breaks down Tylenol, leading to Tylenol toxicity

*ticotimes.net, San Jose, Costa Rica, August 8, 2013.

“What is killing the young men of Cañas?”*

*ticotimes.net, San Jose, *Costa Rica*, August 8, 2013.

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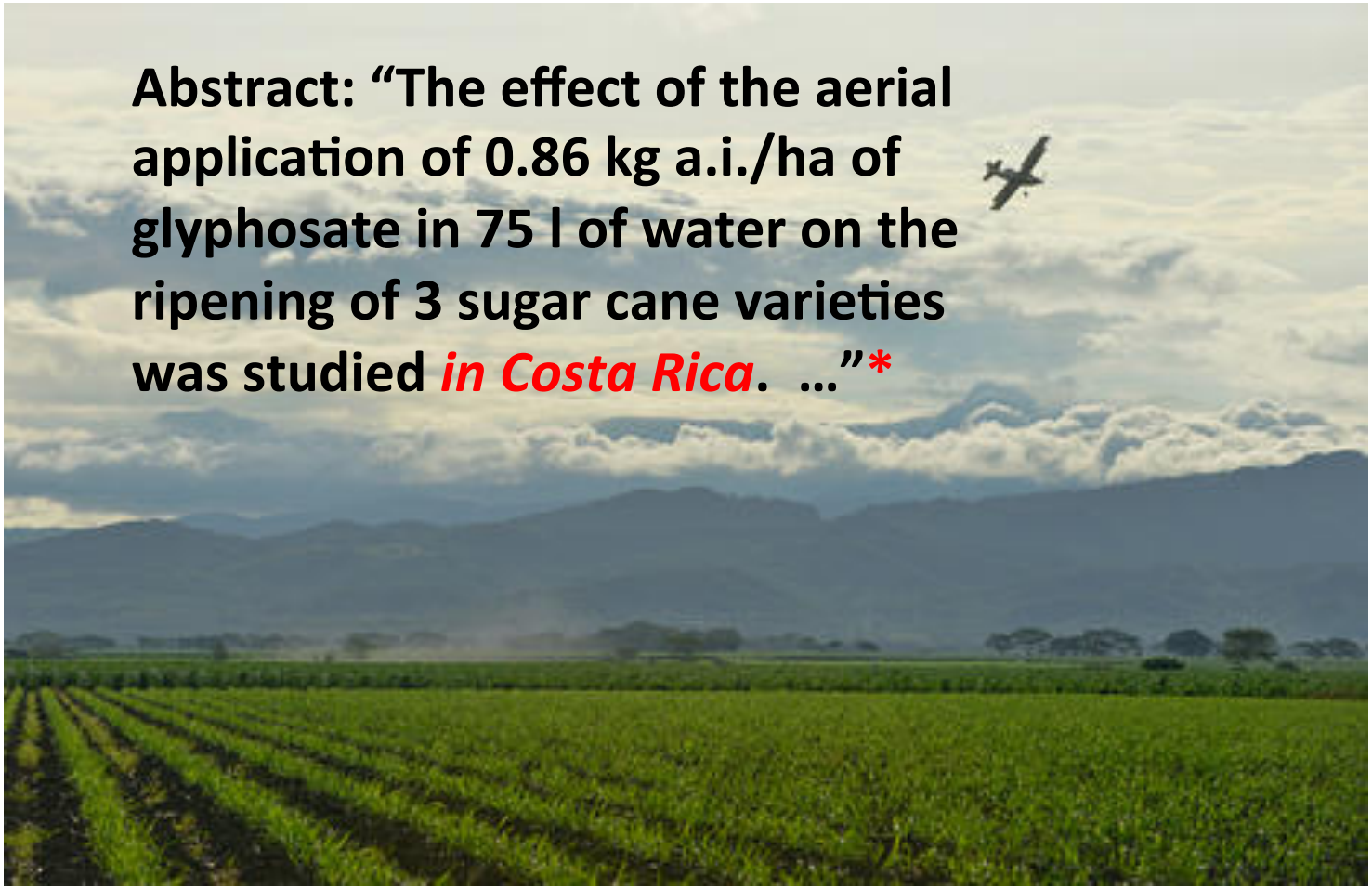
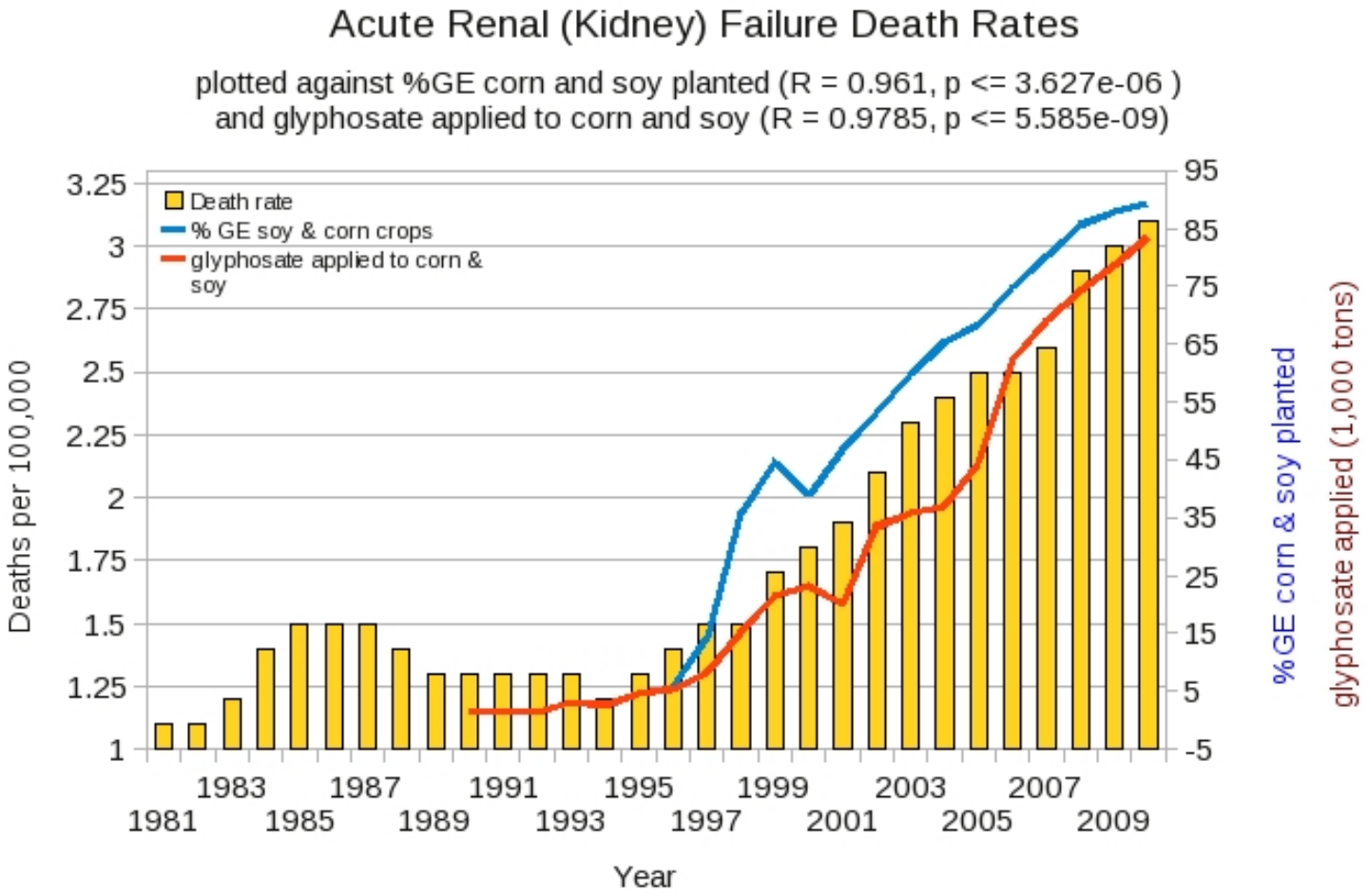


*J.F. Subiros, The effect of applying glyphosate as ripener in three sugar cane varieties, Turrialba *1990*, 40(4), 527-534.

End Stage Renal Disease Death Rate Plotted Against Glyphosate and GMOs*



*Plot prepared by Nancy Swanson from available data online

Recapitulation

- Glyphosate is a known endocrine disruptor
  - Contributes to infertility and birth defects
  - Glyphosate causes breast tumor cells to proliferate at concentrations of parts per trillion
- Glyphosate upregulates retinoic acid which causes microcephaly and anencephaly
  - This could explain recent high incidence of anencephaly in Yakima, WA
- Agricultural workers in Costa Rica and India are experiencing high rate of kidney failure
  - Likely due to application of glyphosate pre-harvest to sugar cane
  - Kidney failure is rising dramatically in the US in step with glyphosate usage on corn and soy

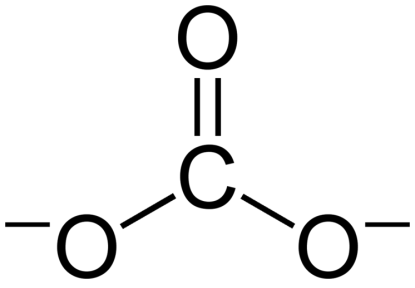
Glyphosate and Sulfate

Rosemary Waring on Autism (1990)*

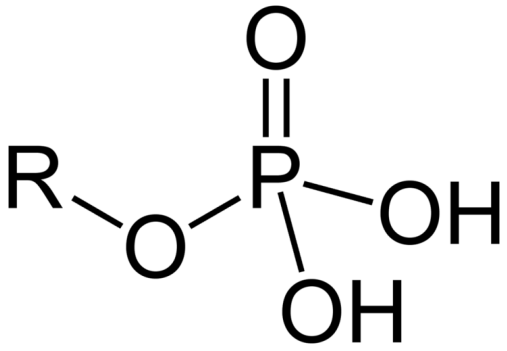
"These results indicate that there may be a fault either in manufacture of sulphate or that sulphate is being used up dramatically on an unknown toxic substance these children may be producing" (p. 198).

*O'Reilly, B.A.; Waring, R.H. Enzyme and sulphur oxidation deficiencies in autistic children with known food/chemical intolerances. *Xenobiotica.* **1990**, *20*, 117–122.

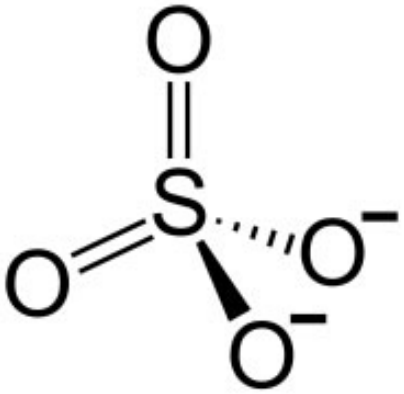
Kosmotropes Gel the Blood



carbonate

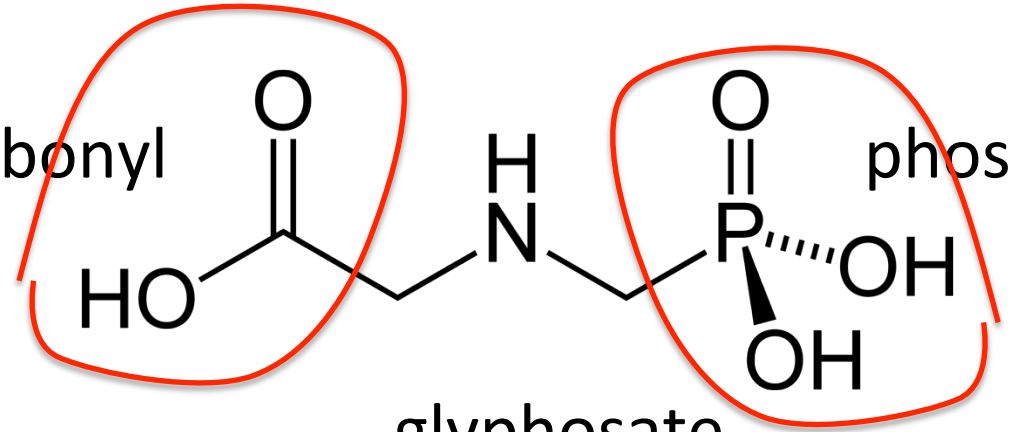


phosphate



sulfate

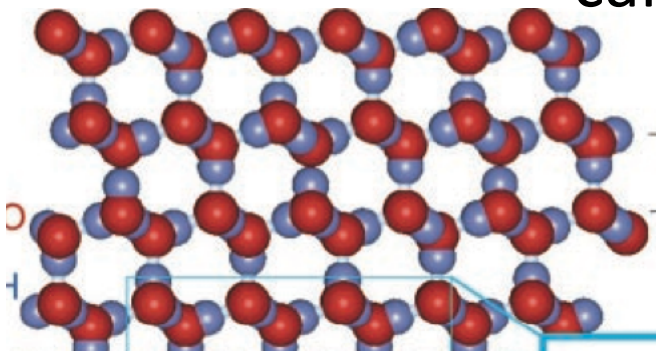
"Liquid Ice"

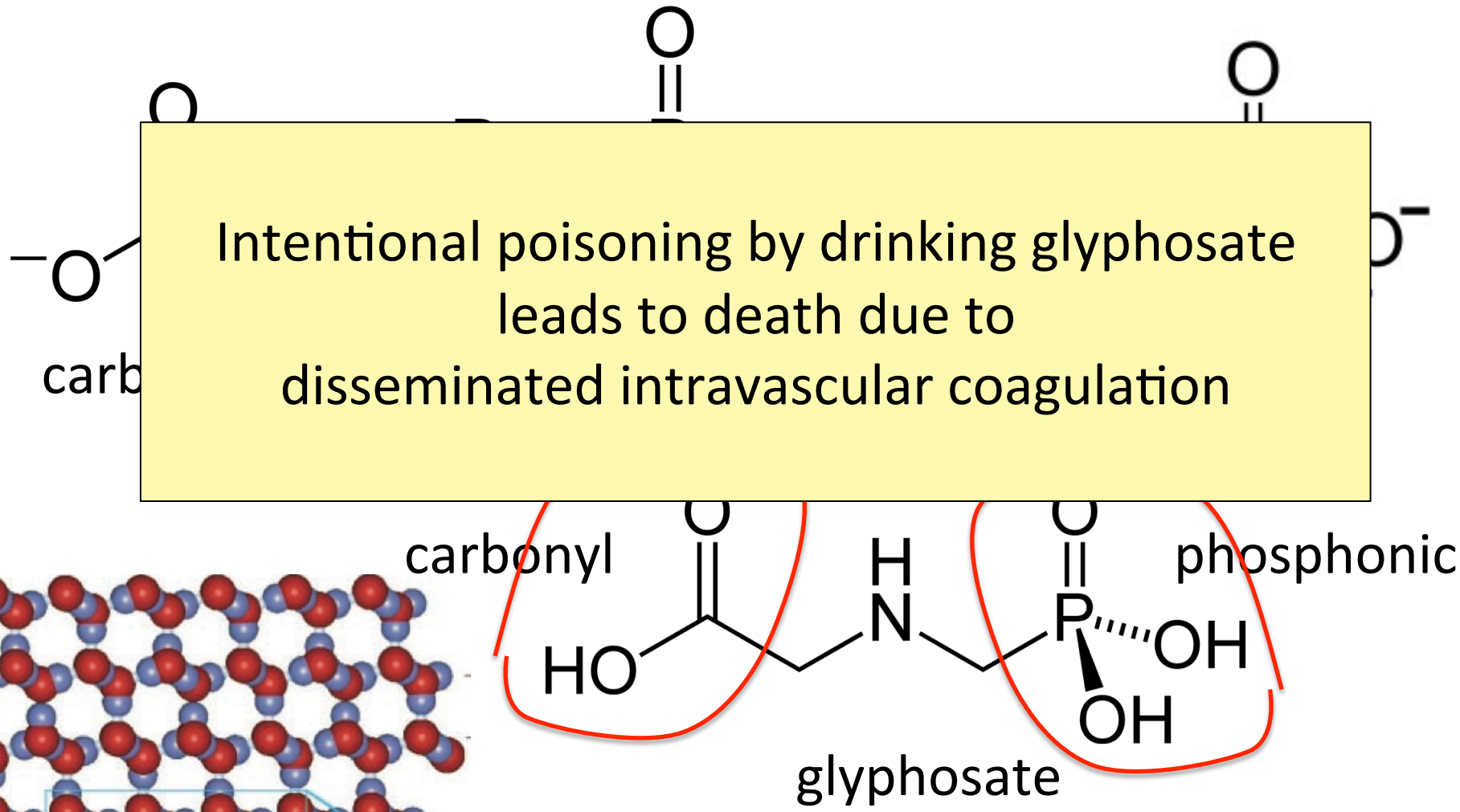


glyphosate

Kosmotropes Gel the Blood

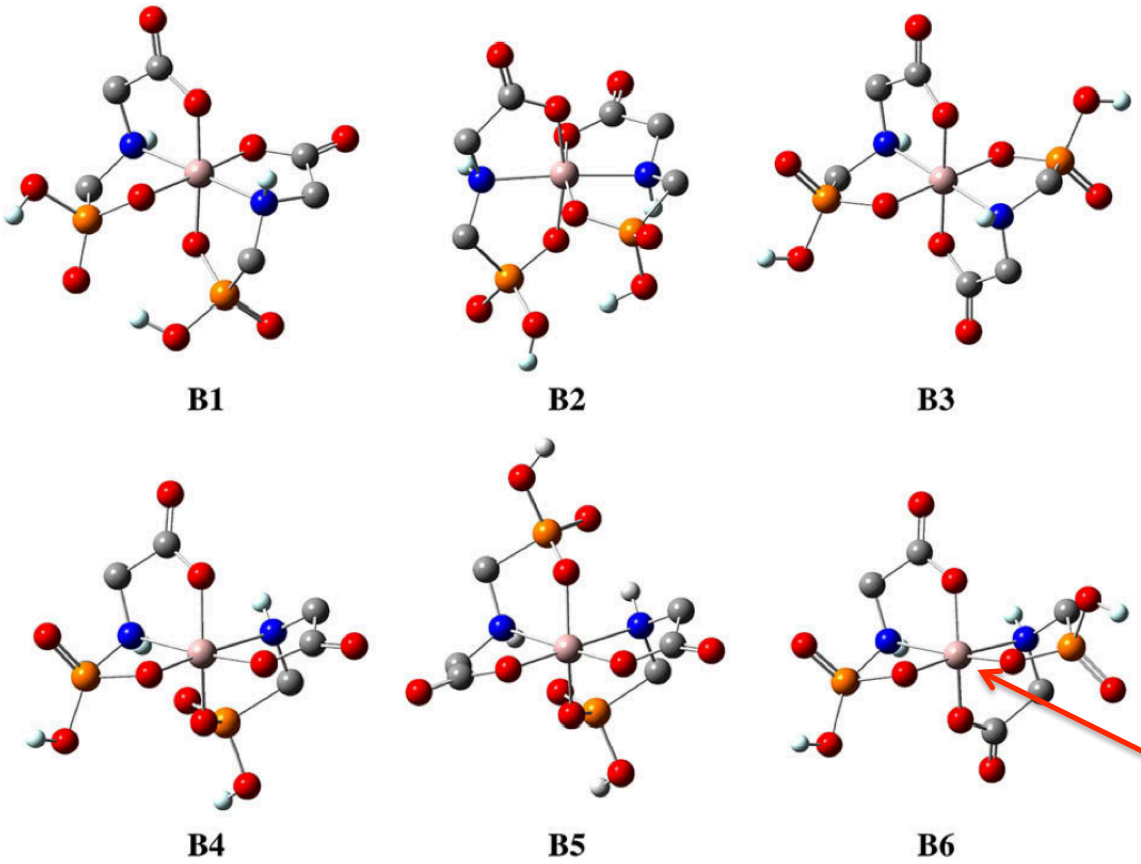
Intentional poisoning by drinking glyphosate
leads to death due to
disseminated intravascular coagulation

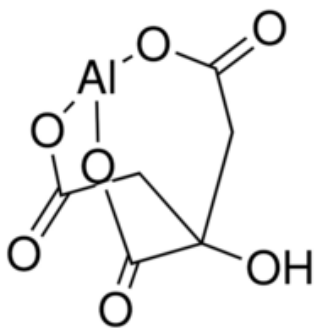




Aluminum Glyphosate*

Six different ways two glyphosate molecules can chelate aluminum





Aluminum citrate**

ALUMINA

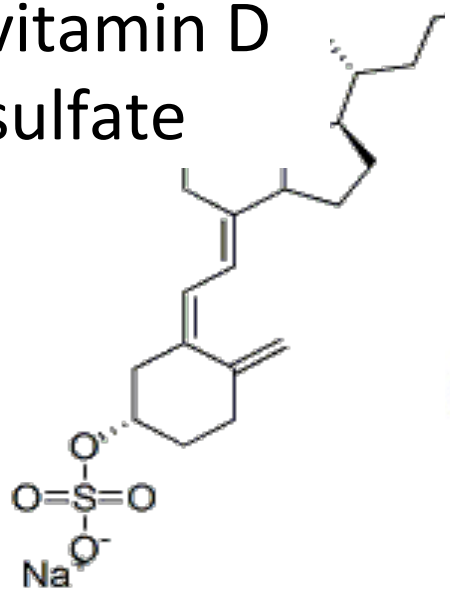
aluminum

*M. Purgel et al., Journal of Inorganic Biochemistry 103 (2009) 1426–1438

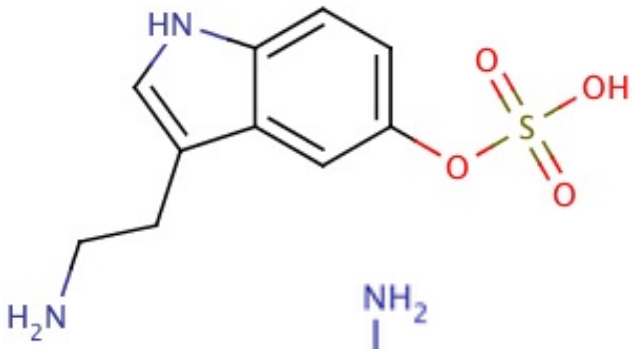
** P. Sianina et al., Clin. Chem. 32/3, 539-541, 1986.

Safe Sulfate Transport: Carbon Rings

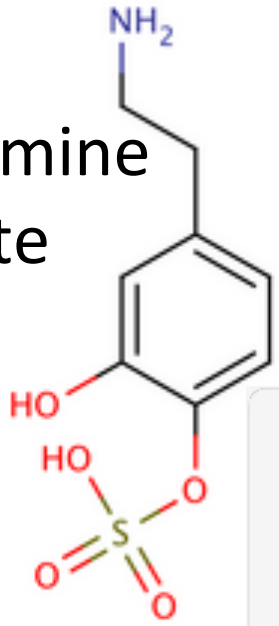
vitamin D sulfate



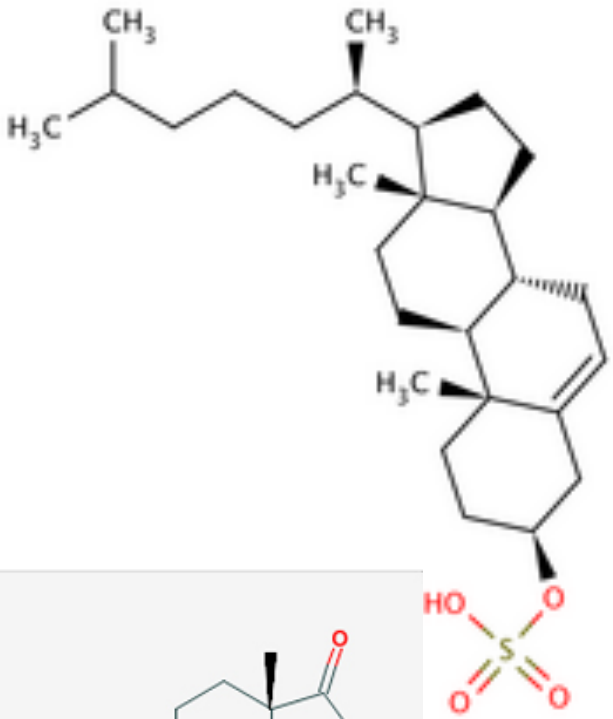
serotonin sulfate



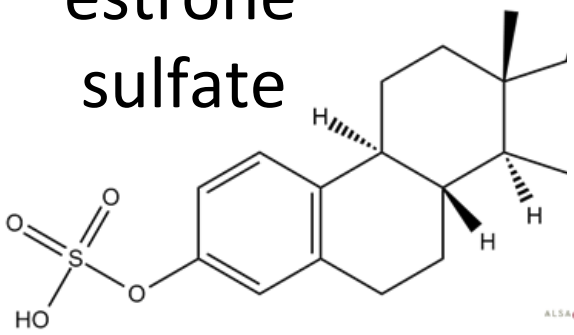
dopamine sulfate

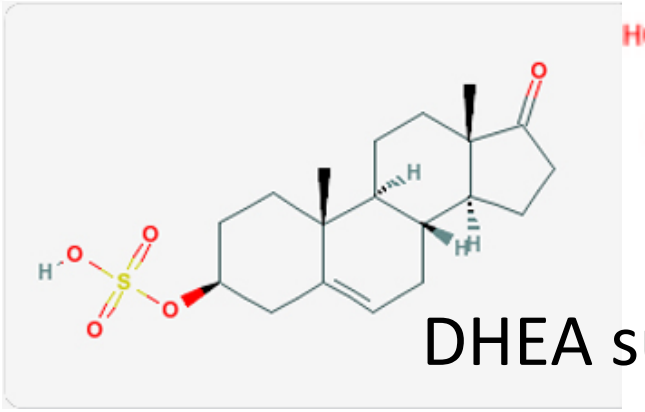


cholesterol sulfate



estrone sulfate





DHEA sulfate

Safe Sulfate Transport: Carbon Rings

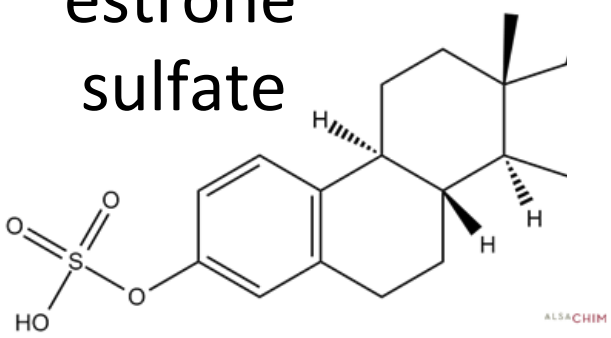
vitamin D sulfate

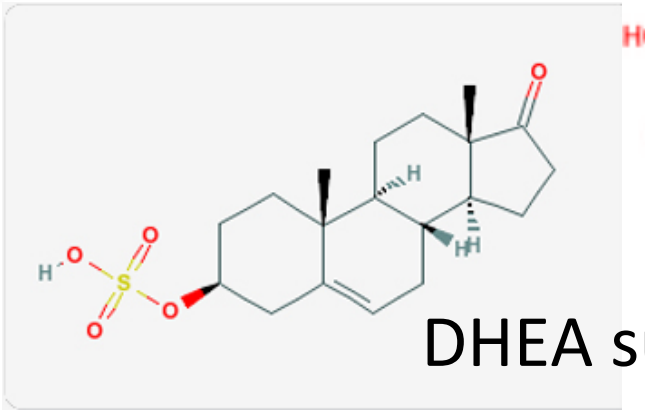
serotonin sulfate

cholesterol sulfate

Glyphosate depletes serotonin and dopamine and disrupts enzymes involved with sterol sulfation: Imperiled sulfate transport

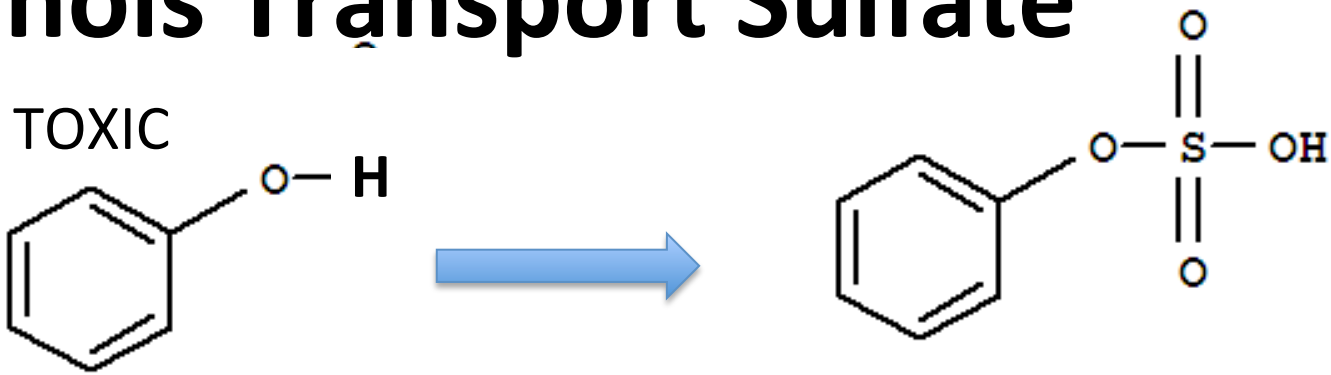
estrone sulfate





DHEA sulfate

Toxic Phenols Transport Sulfate



Clostridium difficile produce p-cresol (toxic phenol) associated with inflammatory bowel disease and with autism

C. difficile is becoming an ever growing problem in hospitals in the U.S.

Recapitulation

- Decreased sulfate supply is a feature of autism
- Glyphosate likely combines with aluminum in gut to produce very toxic complex
- Glyphosate poisoning coagulates the blood
- Safe sulfate transport requires carbon rings
  - Glyphosate interferes with sulfate transport by both sterols and catecholamines
  - Pathogenic bacteria produce toxic phenols which can carry sulfate to liver and pancreas

Evidence of Exposure

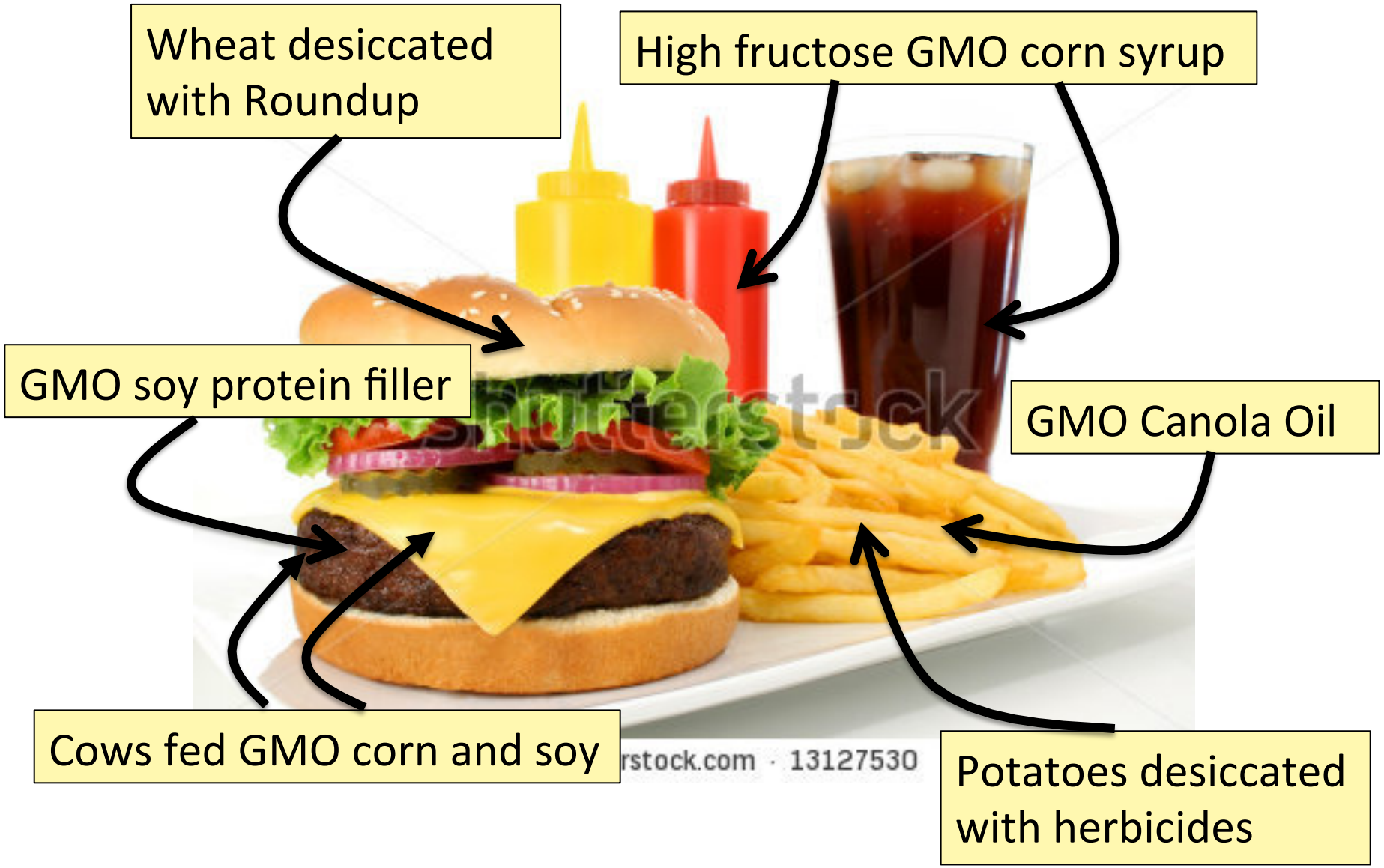
Prof. Don Huber on Glyphosate*

"When future historians write about our time, they're not going to write about the tons of chemicals that we did or didn't apply. When it comes to glyphosate, they're going to write about our willingness to *sacrifice our children and jeopardize our existence,* while threatening and jeopardizing the very basis of our existence; *the sustainability of our agriculture.*"

*Retired professor from Purdue University; Expert in plant pathology
articles.mercola.com/sites/articles/archive/2012/01/15/dr-don-huber-interview-part-2.aspx

The U.S. government does minimal monitoring of glyphosate residues in foods

Is Glyphosate in Our Food?



Testing for Glyphosate Residues in US Foods*

- 195 page document
- Only one food item was tested for glyphosate: soy
- 271/300 samples tested contained glyphosate residues (*90.3%*)
- 287/300 contained AMPA (a breakdown product of glyphosate) (*95.7%*)

*USDA Pesticide Data Program: Annual Summary, 2011

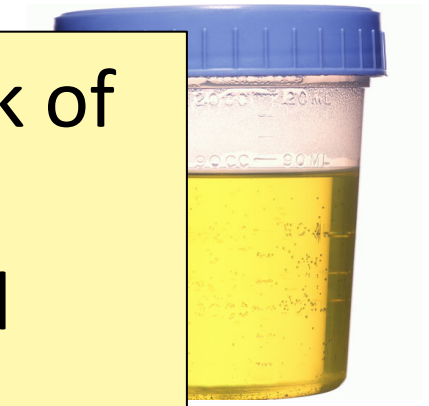
To my knowledge, no studies have been done assessing the effects of glyphosate on humans

"Determination of Glyphosate residues in human urine samples from 18 European countries"*

- 182 urine samples from 18 European countries analyzed for glyphosate
  - city-dwellers who had never handled roundup or any herbicides.
- 44% of the samples contained quantifiable amounts of glyphosate
- 7% of the participants exceed 0.8 micrograms/ Liter, the reference cutoff for "safety"
- Diet seems to be the main source of exposure
- These numbers would be much worse if they were measured in the U.S.

*https://www.foeeurope.org/sites/default/files/glyphosate_studyresults_june12.pdf

"Determination of Glyphosate residues in human urine samples from 18 European countries"*



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"Our testing highlights a serious lack of action by public authorities across Europe and indicates that this weed killer is being *widely overused.* Governments need to step-up their monitoring and bring in urgent measures to reduce its use. This includes rejecting any *genetically modified crops* that would increase the use of glyphosate."

*https://www.foeeurope.org/sites/default/files/glyphosate_studyresults_june12.pdf

Go Organic!


QUE PASA
ORGANIC
Original Handcooked Recipe
Gluten-Free
Stone Ground
RAPUNZEL
ORGANIC CORN STARCH
ORGANIC
SHOYU
NATURALLY BREWED SOY SAUCE
PASTURE-RAISED
Organic HALF & HALF
ULTRA PASTEURIZED GRADE A
Pasture-Raised
ORGANIC VALLEY
FARMER-OWNED
Organic
HALF & HALF
PINT (473 mL)
Ultra Pasteurized
Organic Sweet Cream
ORGANIC VALLEY
4 QUARTERS
Salted Butter
FARMER-OWNED
Produced without antibiotics, synthetic hormones or persistent pesticides

Summary

- We should be very worried about glyphosate in the food and water supplies
- Glyphosate's disruption of gut bacteria, depletion of essential amino acids and minerals, and interference with cytochrome P450 enzymes have widespread consequences
- Glyphosate can explain health problems worldwide, including autism, diabetes, infertility, kidney failure, gluten intolerance, cancer, etc.
- Glyphosate needs to be removed from the market and we need to find the path to sustainable pesticide-free agriculture