Transcript of talk by Stephanie Seneff (senior research scientist at MIT) in Toronto April 28, 2016

Thank you all for being here. It's nice to see so many people and I hope that you will get something out of this lecture that you will remember and then take action when you go home. I want to just start with a quote.

'Those that have a privilege to know, have a duty to act.' (slide)

And I certainly feel that way right now about myself and the knowledge I've acquired about glyphosate and I need to spread it to the world and you guys can help me do that. Can you hear me OK?

Here's an outline (slide), I have a lot of material to cover. Some will be a brief overview and you will have to pay close attention or you will miss things. We'll start with a general overview of the situation with GMOs and glyphosate. And then I'm going to talk about evidence in toxicity.And then I am going to talk about specific topic of glyphosate that I have recently become aware of and I am very, very worried about it, which is the concept that **glyphosate can insinuate itself into proteins during synthesis**. If this is true, it has huge consequences and those consequences easily explain all the correlations we are seeing with multiple diseases like Alzheimer's and autism. So I am quite excited about this, and Anthony Samsel and I have a new paper which is ready for proofs. When that comes out you can read it in gory detail; there's a lot of information in that paper. (Slide) In that concept of gylphosate and proteins I am going to talk about sugar beets, glyphosate, MS and Mad Cow disease, a very interesting story emerging there. Second topic is collagen, arthritis and vaccines; neurological diseases, diabetes, obesity and adrenalin deficiency... and finally how to safeguard yourself and your family. Lot of material. We're going to try to move quickly along.

This is the new childhood in America (slide). Kids are sick in our country,and it is probably similar in Canada; 1in 3 overweight, 1 in 6 has learning disabilities, 1 in 9 has asthma, we've got ADHD, lots and lots of food allergies, seizures. And then the really scary thing to me is autism; 1 in 54 males and 1 in 88 children, updated to 1 in 68, and half the children are either overweight or have a chronic illness. We are in trouble in America and we need to understand why.

Roundup – what is glyphosate? How many have heard the word gylphosate here? That's really good news because I think the word is getting out. It was a pretty obscure word a few years back. (slide)

That is Roundup. You can kill dandelions in your backyard or you can spray Roundup poison all over your food crops. Which is what they do with the GMO Roundup ready crops; corn, soy, sugar beets, cotton, tobacco and alfalfa have all been engineered to resist this chemical, otherwise it kills all plants. So something that kills all plants is not

likely to be non toxic to humans, although Monsanto claims that it is. They also spray it on other crops right before the harvest as a desiccant, and those crops are likely to end up with a lot of gylphosate in the food that is dried with them, and that includes wheat, sugar beets and oats. Some very basic foods there as well as non-GMO but still sprayed with gylphosate. (slide)

So this is the plot that scares me. The blue boxes are the autism rates in the US in the first grade according to the IDEA which gives you extra help for the children diagnosed with autism over time. On the left is 1995 when it first starts and goes on to 2011 on the right. The red is the gylphosate use on corn and soy crops over the previous four years. So that is from the age of 2 to the age of 6 in that child's life and the correlation is incredibly perfect - 0.997 - 1.0 is the best you can be, of these two curves. They basically coincide with a hugely significant result.

(slide) So why is this increase in gylphosate? Well Roundup is used on Roundup ready crops and they were first introduced in 1996. They were a low percentage of the crops. This is your soy, cotton, corn. This middle one is an average/combination of corn and soy, the blue one, and yellow is the soy. And you can see by the end 2012 - this is a great graph – by the end you have a very rapid adoption of these crops. By 2012 you have 90% of all of these crops are GMO engineered to be used with Roundup Ready and what happens is these Roundup Ready weeds have appeared among these Roundup Ready crops – weeds that resist glyphosate - so they've had to use more and more every year to fight these weeds. And now they are facing some serious problems of what to do next because the gylphosate isn't working anymore.

(slide) I was really glad to see this in Newsweek Feb. 2nd 2016 because it is unusual to see these kinds of things in main stream journals. Gylphosate usage has increased 50 fold since 1996. Today 50 times more gylphosate is allowed by the EPA on corn grain than in 1996. Half the American farmer's fields have weeds that are resistant and now they are saying we have added to some more resistance. Let's add another chemical here. Let's try 2,4-D which is a component of Agent Orange in Vietnam. We'll just add that, we'll put that in as well because that can kill the weeds that are resistant to gylphosate. So then we have this duo which has been approved in the US along with these dual resistant crops.

(slide) So here is some statistics on gylphosate residue and their effects in the studies. 0.1 ppb - that's a very tiny amount of exposure - alter the gene function of over 4,000 genes in livers and kidneys of rats. Also 0.1 resulted in severe organic damage in rats. And that is 0.1 permitted level for gylphosate and other chemicals allowable in EU tapwater. 10ppb show toxic effect levels in livers of fish. 700ppb is what the US allows in US tap water. I looked up Canada and it 280ppb so you're better than US but much worse than EU. And 11,900 ppb is what was found in GMO soybeans. So there's where we sit.

(slide) Zen Honeycutt is a hero of mine from Moms across America. She founded Mom's across America and she has measured gylphosate in various things and she found levels in breast milk from Americans, who were being fairly conscientious about avoiding GMOs, 1600 times higher than the level allowed in the water in Europe.

(slide) Glyphosate in cotton products. This was quite shocking to me but maybe not surprising because cotton is a GMO crop. Researchers in Argentina want to use these products as a baseline expecting it to be 0, and they were shocked to find that 85% of the products they tested had a significant level of glyphosate including tampons and sterile cotton gauze; think about Pampers baby diapers. In 2014, 96% of cotton produced in the US was GMO modified to resist glyphosate so you do have to worry about the clothing your children are wearing. Maybe that's why they have eczema. We have an epidemic in eczema right now.

(slide) So is gylphosate toxic? Monsanto says no. It's a great product because it works on this shikimate pathway which humans don't have that pathway in their cells. So it's good, we're great and don't have to worry about it. But there is a big consideration there in that our gut bacteria do have this pathway, and they use it to make really important products that we need because we can't make them. Things like the aromatic amino acids which are precursors to all our neurotransmitters as well as folates, dopamine, serotonin, melatonin, melamine the skin tanning agent – all these things are derived from shikimatic pathway. So they are going to be deficient if our microbes can't make it and, furthermore, our microbes aren't going to be able to do well so it kills off the beneficial bacteria. So it allows the pathogens to gain a foothold in the gut and ends up with a lot of gut problems. Also Roundup is not just gylphosate. There are other products in there. First of all, they add salts to make the gylphosate more soluble and then they add surfactants that allow the gylphosate to get into the cell and also are in and of themselves toxic, so the Roundup is much more toxic than the gylphosate. Pure gylphosate is what they study in the lab, And furthermore gylphosate effects are insidious. You don't immediately know that you are being poisoned. It takes time for the poison to develop so you start seeing symptoms. And they made a rule that you only have to study for three months, and lots of times the problems don't show up until four months.

(slide) So here are the main toxic effects. One thing we noticed ... Anthony Samsel and I by the way wrote this paper in 2013 in Entropy, and this was my first paper on gylphosate. And we found literature that shows it interferes with the functions of these very important enzymes in the liver called cytochrome enzymes, and I'll talk about them a bit later. It also chelates a lot of minerals that are probably important to our enzymes which depend on minerals as catalysts. And glyphosate holds onto to those minerals and won't let them go. And so it messes the whole way the body transports these minerals, and you can actually release them and cause the mineral to be toxic. And these minerals need to be managed very carefully because they can be toxic if

they are in the wrong place at the wrong time, and glyphosate makes it very difficult for the body to manage it correctly.

I mentioned the aromatic amino acids but also methionine which is at the base of the sulphate pathway which is also disrupted by glyphosate and that leads to shortages in the neurotransmitters as well as folate. And it disrupts sulphates as it is a sulphate transporter, and I've identified sulphate deficiency as a key driver behind most modern diseases. I talk a lot about that in my research.

(slide) So the central mechanism; it acts as an antibiotic to disrupt the gut bacteria letting the pathogens overgrow, and the disruption of CYP enzymes lead to impaired bile flow and low Vitamin D because you need the CYP enzymes to activate the Vitamin D. And you also need the CYP enzymes to detoxify many other toxic chemicals in the environment. So it makes chemicals more toxic than they would otherwise be because you can't break them down. Damage in sulphate synthesis and sulphate transport. It damages the red blood cells, this has been shown in some of the studies I've been reading, and that leads to anaemia We have an epidemic in anaemia worldwide. And it also at the same time leads to toxicity due to the free iron that is released by the damaged blood cells. You get hypoxia, low oxygen, because the red blood cells need the iron to carry the oxygen. And then you get into a low grade encephalopathy, and you get into a leaky brain. And you can get other dangerous metals like aluminum and mercury getting into the brain and causing trouble.

(Slide) So evidence of toxicity. I've mentioned the CYP enzyme. This was a study done in 1983 when they looked at several different chemicals. 2,4-D is another herbicide, cofibrate, MCPA and glyphosate. And they looked at the CYP enzyme activity in the liver of the rats. And they found only glyphosate, the control is on the left, and the glyphosate you can see on the graph drastically reduced the activity on the CYP enzymes whereas some of the other ones actually increased the activity. Glyphosate was by far the worst. And this is going to affect the bees. You know we have an epidemic, a crisis in bees in America and also elsewhere in the world. They need those enzymes to detoxify the neonicotinoids. You know everyone is saying neonicotinoids are the problems with the bees, but glyphosate is also in the mix and then the neonics become much more toxic.

(slide) Minerals I also mentioned. This is some data from Don Huber, one of my personal heroes. He was one of the first persons I heard from about the toxicity of glyphosate. He has here the minerals iron, manganese and zinc, and he shows the roots and going up into the shoots of the plant. The control is the green at the reference level, so you can see tremendous reduction of manganese in the roots and even more in the shoots. And the other ones are also all down in the shoots. These minerals are deficient in the food you eat which is going to lead to personal deficiencies as well, human deficiencies. And Anthony and I have a whole paper on the manganese problem. I'll say a little bit more about that here.

(slide) This is a plot from a paper by Margaret Kruger. This is the minimum you expect of manganese in the blood of a cow, and this is the maximum. This is the range you would expect. There were 8 different farms, and they were all below the minimum expected level. Same for cobalt. Cobalt was practically non-existent in the blood in these cows. And the cows were tested and they all had tested positive for glyphosate in their urine. So they suspect that glyphosate is preventing them getting enough manganese. Manganese deficiencies are causing a lot of problems, and I think it has direct connections to autism.

(slide) I can see things that are directly associated with autism. They include lactobacillus which is the microbe that really needs a strong start in your gut after you are born, and they critically depend on manganese. They use manganese in ways that other microbes don't, and they are going to be harmed. And that is what is going to set you off in a wrong balance of microbes in the gut.

Manganese superoxide dismutase is essential for protecting the mitochondria from damage. Mitochondria are the source of ATP. ATP is the energy source for the cell. It is also essential for detoxifying glutamate which is a neurotoxin, and autistic kids have high glutamate. There is lots of evidence of high glutamate in autism that will burn out the neurons in the brain if you can't get rid of this through the manganese. And the pituitary depends on the manganese to release thyroid stimulating hormone. So if the pituitary is manganese deficient you are going have low thyroid, and we have a lot of issues with low thyroid. Chondroitin sulphate syntheses in bones depends on manganese and that means that the bones will be sick as well.

(slide) This was a paper on the adjuvants which was quite surprising to me. They claimed that up to one thousand times more toxicity for something like Roundup compared to glyphosate because of the adjuvants in the pesticides. And this is true more generally for the other pesticides as well.

(slide) Then they had this lovely quote: 'It is commonly believed that Roundup is one of the safest pesticides. Despite its reputation Roundup was by far one of the most toxic among the herbicides and pesticides tested. And this inconsistency between scientific fact and industrial claim may be attributed to huge economic interests (which of course it is), which have been found to falsify health risk assessments and to delay health policy decisions.' So this is really a huge problem that we face a very toxic chemical pervasive in our environment very carelessly monitored, and we are all thinking that it is fine. You know. So it is very scary.

(slide) This is an article by Séralini et al studying rat exposure. I thought this hadn't been done for the full life span for Monsanto early on. Turned out they had early experiments but buried them so we weren't really aware of them. But Séralini found massive mammary tumours in the rats that were exposed to low environmental levels of glyphosate throughout their life span. He didn't see any problems at three months but at four months he started to see issues, and by the end of it, he found a lot of

issues with both females and males. He had the mammary tumours in the females, and males had increased liver and kidney disease. Sex hormones were disrupted for males and females, and he saw enhanced oxidative stress. As I said, the effects started at 4 months because at 3 months you didn't see anything.

(slide) This is a paper I really like. Nancy Swanson is a friend of mine, and she published this paper with other colleagues called Genetically Engineered Crops, Glyphosate and the Deterioration of Health in the United States of America. And she has something like over 30 figures in that paper, and I'll just show you a few of them. I'll show some more when they become appropriate but these are all figures that are showing all these diseases that are growing dramatically in the US in step with dramatic increase with Roundup. So we have thyroid cancer, diabetes, end stage renal disease, kidney disease, and urinary and bladder cancer. These are just some examples from her paper, and in all cases you see very strong. The red is the glyphosate and the blue is the usage of the Roundup Ready crops.

(slide) As many of you already know, The WHO has declared glyphosate a 'probable carcinogen' in 2015 and that has stirred up a lot of trouble in the regulatory process.

(slide) So in the conclusion: 'Although correlation does not necessarily mean causation, when correlation coefficients with 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.' I am certainly doing that. And what I have been doing is trying to understand how glyphosate could be doing these things. What could be the biological underlying mechanism that would do that?

(slide) I want to have one more here on antibiotic resistance which is a very serious concern of mine. As you probably know we have a lot of issues with multiple resistances of microbes in the hospitals causing people to die after going in for some innocent operation and end up dead because they pick up some infection in the hospital and you can't kill it. You give them every antibiotic you can think of. Glyphosate can make that happen because it teaches the microbes how to flush out the toxins not just glyphosate but the other antibiotics that come their way. It gives them a general solution to flush them out, keep their levels low so that the microbes can still get in. And it also enables the pathogens to get into the host cells. That could be a major factor I think in the epidemic we are seeing in antibiotic resistance.

(slide) So now my major topic here. You guys are among the first to hear about this so I'm excited and I know you will be too.

(slide) What's the concept? Well **glyphosate could be inserting itself during protein synthesis directly into when you are making a protein.** I don't know how many of you have enough biology to know when you are making a protein, you have beads on a string. You have the twenty or so basic amino acids and those are the coding amino

acids. You have DNA on a code - so for example GGC codes for glycine. **They are building the protein from the DNA sequence, and they say OK we need a glycine so they grab a glycine, but this is not a glycine it is a glyphosate.** But this part is glycine. It's got something stuck onto the nitrogen but otherwise it's glycine so the system could be confused. And you put this in there instead of glycine. And **if it does that, it is huge and has effects everywhere. So there is your glyphosate, and it goes into the protein instead of the glycine. And this will mess up how this protein behaves, and mess up and prevent the protein from doing its job correctly, and also cause the protein to resist it from being broken down So it is a really bad scene. And so you make a protein that doesn't work and usually you break it down and make it again, but you can't because glyphosate makes it hard to break it down as well, So you accumulate this protein debris that can cause a lot of damage to your cells. And** (slide) **so I said that "glyphosate is a synthetic non-coding amino acid analogue of glycine'.**

So I started looking at the research literature to find out what are some of the proteins that absolutely require glycine at a particular point to work properly. There are a lot of papers on this. It is very fascinating and I can see then that, Oh my God!, that's all the diseases that are going up in step with glyphosate. And I am going to go into more detail about not all of these, because obviously we are short on time, but many of these I will talk more about in a moment. And this is where the new paper coming out with Anthony and me talks about all of these conditions.

(slide) Neurological diseases, neural tube defects, celiac disease, impaired collagen which has huge amounts of glycine. And collagen is in the joints and we have a huge problem today with joints. Many people have rheumatoid arthritis, and if the glycogen has glyphosate in it, you are going to be in trouble. It won't form its proper crystalline form, and it also then won't be able to be broken down and re-synthesized. Osteoarthritis, steatohepatitis (fatty liver disease), obesity and adrenal insufficiency, impaired iron homeostasis, which can lead to kidney failure, and we are seeing kidney failure among the agricultural workers multiple places around the world. In Central America and Sri Lanka and in India, they're finding kidney failure with workers with glyphosate on the farms. Insulin resistance and diabetes, cancer, autoimmune diseases. So that is quite a list.

(slide) So first of all we are going to defend this idea of glyphosate getting in on the basis of other examples. First of all, this which is a paper that just came out. I was delighted to see this paper looking at glyphosate effects on the Rhizosphere - That's the area of soil around the roots of the plant. And they used a sophisticated RNA sequence analysis to find out which proteins were being expressed and which ones were being suppressed in the presence of glyphosate, and they found lots and lots of changes, but a critical thing they found was increased production of the enzymes that were involved with making proteins and increased production of enzymes that were involved with breaking proteins down. And what that means is that they are finding

that the protein making machine system that works is somewhat careless so it makes a lot of mistakes, and if it doesn't work, they will break that down and make it again. That's how the system works, but if you got glyphosate getting in the way, you are going to have lots of cases where you made a protein that didn't work and now you are going to have to be spinning your wheels making it, breaking it down, wasting a lot of energy producing proteins that don't work. And that's why you would increase the level of these enzymes.

(slide) I found some other interesting stories, other examples of toxins. These are natural toxins produced by plants that work by replacing amino acids with a fake one. So this is a fascinating story about an epidemic of ALS, Lou Gehrig's disease, in Guam which occurred after WW2, And they found this natural toxin, which was produced by these cycads which people were eating, called BMAA. And it is a non-coding amino acid, and it's an analog of serine. It is another of these amino acids. Just like glyphosate is like glycine, BMAA is a substitute for serine and that causes for example a defective version for glutamate transporter which has been linked to ALS. And that transporter has a serine agent that will get messed up if the serine is replaced.

(Slide) Another example is MS (multiple sclerosis) and sugar beets. Sugar beets contain an analog of proline called AZE. And they have found that people that live near sugar beet farms have higher rates of multiple sclerosis than other people around the world. In Japan, in Europe, here in Canada, and in the United States, they've seen this correlation between living near sugar beets and which maybe in sugar beets but also eating animals that eat sugar beets because we feed sugar beets to the animals. You can get this toxic amino acid into your system and then it will mess up all the proteins that contain proline. So for example myelin basic protein contains a cluster called of proline residues that are absolutely essential for it to work. If those are substituted with AZE than the myelin basic protein don't work and you get into trouble with the myelin sheath.

(Slide) And here's a third example which is a non-coding amino acid called L-canavanine. A real fascinating story about a guy named Chris McCandless, who went into the Alaska wilderness in 1992. A book was written about his story, Into the Wild. And towards the end of his life, he was eating seeds from a lot of potato plants that grew in the Alaskan wilderness, and those seeds turned out to be contaminated with this natural L-cavananine which eventually cause him to die of starvation because it messed up his metabolism.

So that's three examples. So glyphosate is just part of a collection of amino acids that have this property.

(Slide) Here is the story of Sugar beets, Glyphosate, MS and Mad Cow.

(Slide) Quite fascinating story that we have been working out. Mad Cow is also called Bovine Spongiform Encephalopathy, and this is something that happened to the cows

in Great Britain. They were being fed cow parts in their feed, cow brain in their feed, and being poisoned by whatever proteins, these not properly folding proteins in the brain. So it is related to some nasty diseases humans get like Jacob Cruzveldt disease. This was popularized during that time when we had all that fear about Mad Cow. So cows are actually fed a large amount of sugar beet pulp which is a residue from sugar processing. When you pull the sugar out of the sugar beet you are left with this pulp, and they put that into the cows feed. So that could be a causal agent because of this problem with the proline.

(Slide) And so I found this article from 1986 which was talking about using dried molasses sugar beet pulp to feed some of the cows. I figured they were doing this around the time of the Mad Cow. They eat this sugar beet that has this nasty amino acid in it, and then it gets into their brain. And then they eat the brain and it reinforces it so you get a higher concentration. And it takes the cow down with something that is sort of like MS.

(Slide) Well it turns out that root rot is something that occurs in sugar beet, and that glyphosate increases the risk. So glyphosate can cause this fungal infection in the roots in sugar beets, and AZE has been shown to have anti-fungal properties. So you might imagine, this is not technical and I am just guessing, I would love to find out. But it may be that the sugar beets exposed to Roundup, Roundup Ready Sugar beets, have a much higher concentration of AZE because of the fact they are fighting this fungus infection. It would make sense, so that maybe it is a worse problem with the GMO sugar beets than with non-GMO sugar beets which are not exposed to glyphosate.

(Slide) Then there is a connection to particular microbes that are resistant and that can actually metabolize glyphosate. And so amazingly I found a paper that they were looking for microbes that could fully metabolize glyphosate. That's a good thing to have, because you can get rid of it that way. If you have one of those microbes growing in your body, it can clear the glyphosate. That CP bond in glyphosate is very difficult to break. Most microbes can't do it. So this article talks specifically about two that could, and those two turned out to be exactly the same two that were talked about in a paper that said these are the ones that were found both in the cows that had Mad Cow and in humans with MS as well as Type 1 diabetes and celiac disease. All of these diseases are going up in step with glyphosate usage of corn and soy crops. It's very tempting to say there is a whole complex thing going on here with the sugar beet, the glyphosate, and with these two microbes growing and flourishing and metabolizing glyphosate by putting it into some of their own proteins. So now you have glyphosate contamination into proteins that are getting into our system and then those proteins match. There's something called mimicry when you get an antibody to a protein from a microbe that closely matches a protein in your own body. You can develop an auto-antibody to that protein in your own body and that is what they think is going on here in this paper. So it is very fascinating. And so the Acetobacter for example is making a protein that has

glyphosate in it and as a consequence it can't be broken down. Then your body reacts to the antibodies and it in fact gets into your brain. This microbe infects your nose, so it is pretty easy to imagine it can get in to your brain. And then you get immune cells in the brain responding to this microbe protein that has glyphosate in it, and then in turn responding to the myelin beta protein to cause inflammation of the myelin sheath. So really nasty, nasty possibilities going on there with these auto-antibodies derived from the antibodies to the microbe proteins that have glyphosate contamination in them.

(Slide) So that is my hypothesis - suffice to say that 'These microbes are exposed to high levels of glyphosate and they incorporate it into their proteins by mistake, leading to impaired proteolysis (can't break it down) and antibody development' and then auto antibody as a consequence.

(Slide) So very interestingly in another paper that I found, or maybe in the same one, they actually showed the sequences that were similar between the Acetobacter and to these two different proteins that are considered to be connected to MS. MOG and MBP (myelin basic protein). Those two proteins have sequence similarity which cause the mimicry which give you the auto-antibodies, and every single one of these has glycine in it. It is very suspicious to me that that glycine is the problem causing this reaction.

(slide) Collagen, arthritis and vaccines.

(slide) I told you I think gelatine - 25% of the protein in our body is collagen. That is a huge portion in our body. And there is a lot of glycine in collagen. I think 25% of collagen is glycine. So you really have a lot of chances for glyphosate to get into our collagen. It forms these triples of Gly-X-X, with glycine as the first one and then the third one, one of the other two are often proline. So you have a chance of proline being messed up with AZE from sugar beets as well. So glyphosate substitution for glycine will mess up the triple helix. So collagen won't perform as it should in the joint. Gelatine is derived from collagen and that is typically from the collagen that is in the ligaments that are sourced from cows and pigs. And these animals are fed high doses of glyphosate in their GMO Roundup Ready feed so you can imagine there would be lots of glyphosate in the gelatine.

(slide) So you start to worry about things that contain gelatine, things like gelatine capsules for your pharmaceutical drugs or your nutraceuticals. Jell-O, you have gelatine in make-up or in vaccines. Vaccines are one that really concerns me right now. I am concerned about the possibility of gelatine in the vaccines contaminated with glyphosate and resulting in glyphosate contaminated vaccine.

(slide) So MMR flu vaccine and rabies vaccine are live virus grown on gelatine which are derived from the ligaments of pigs and the pigs have had a significant dose of gylphosate in their feed. The gelatine contains a significant amount of glycine and also glutamate which is the neurotoxin I mentioned before glyphosate disrupts your ability

to detoxify the glutamate because of the manganese problem. And so glutamate and the glycine work together as a team to excite the NMDA receptors, and excessive NMDA receptors excitation can lead to neural burn out so you can destroy your neurons from too much excitation from these two amino acids.

And so we can also have glyphosate substituting for glycine and working to excite the NMDA receptors because it is a glycine mimetic. So this is a worrisome idea to think of these getting into the brain of a child particularly if that child has been exposed to glyphosate in their food, and now have a leaky gut barrier and a leaky brain barrier. The glutamate and glycine will easily get into the brain to cause this damage. Interestingly enough there are three plots here that are well correlated. I have already talked about children with autism and glyphosate application.

These are two different – these aren't quite the same plots I've shown you before. This is the CDC's numbers for autism, and the glyphosate is not individual for four years. These are just individual numbers for each year but those two curves are already quite well correlated. The red is for the children and the blue is the glyphosate application on the core crops – the yellow curve is simply a count of the number of reports in the virus database reporting system put out by the FDA every year going back to 1990 on the left and 2010 on the right. And what is interesting is that the yellow curve is also going up in step both with autism and the glyphosate. All three of these curves are matched. We don't know whether there is a causal relationship here but what I am suspecting is that over time you are more and more likely to get glyphosate into the vaccine which will then cause the vaccine to be much more toxic and that's why you get this increase in the number of reports. And in fact you see it is very sharp, there is a really sharp rise right there around 2006 of the number of vaccine reports. 2006 was when they introduced a glyphosate salt formulation. It was probably; it was designed to be a bit more toxic to the plants and was probably a bit more toxic to the humans as well.

(slide) I did some studies on the MMR vaccine from the VAERS (VAERS stands for Vaccine Adverse Event Reporting System) database. And I looked at the number of adverse reactions, the symptoms of the adverse reactions before and after to the midpoint. So I just took the early data, equal time, the late data and counted out the number of cases where certain symptoms were occurring. And these numbers are based on a sub sampling of both sets so that I have exactly the same number of kids at each age group. So I normalized for age and normalized for count and just looked at the relative number of events. And you find there was only one symptom that was common before. The early data was joint pain, and there are a lot of symptoms that were common in the later data including hospitalization, seizures, autism, eczema, facial swelling, and anaphylactic shock. A lot of nasty things. Hospitalization here is 6 times more frequent and it is actually worse than that because it is actually 50% more data, so it is nine times more, in raw count hospitalizations in the later data compared to the early data. Something is making MMR more toxic than it used to be. So these symptoms are all

features of, characteristics of allergies to MSG (monosodium glutamate) which is therefore a glutamate allergy. And so you could expect that it could be the glutamate in the vaccine that is causing these symptoms working synergistically with the glyphosate to excite the NMDA receptors.

(slide) And in fact here is a paper on glyphosate and glutamate showing that acute exposure activates NMDA receptors and also activated these calcium channels, introduced oxidative stress, killed the neurons and increased the glutamate released into the synaptic cleft –excessive extra cellular glutamate levels – so that is going to increase the availability of glutamate in the rat brain as a consequence of exposure to glyphosate, and depleted glutathione which is an important antioxidant, and it showed evidence of damage to the fats from the exposure to the oxygen.

(slide) So this gets even more interesting when you think back again at molecular mimicry when you think about MMR similar to the story that I told with MS and Acetobacter. It turns out that MMR also has a protein that matches a piece of the myelin basic protein (MBP). So just like the story with MS, you could have a measles virus grown on a gelatine that's contaminated with glyphosate. The virus puts the glyphosate into its hemagglutinin. Hemagglutinin is the thing you need to get the antibody to take. That's what they are looking for, but if you get the measles in a virus which is a live virus, if the infection takes hold because you have a weakened immune system because of your chronic exposure to glyphosate, you get infection in the gut and then that migrates into the brain. So you can have the measles infection in the brain which is going to cause a sort of encephalopathy reaction. And then the hemagglutinin, matches the myelin basic protein so you get the auto-antibodies to the myelin sheath which is connected to autism. So autism actually has a link. In papers they've shown high antibodies to hemagglutinin of measles and high auto-antibodies to myelin basic protein. So this all kind of makes a good story, a scary story, but it kind of works as a way to explain the issues with MMR. We're seeing more and more issues with MMR in recent times, and in fact I just got emails from someone who shared with me whose daughter has autism. She was given an MMR vaccine when she was young. It gave her measles. She got a live measles infection and caused a kind of anaphylactic shock. His wife also then got measles from this child. The wife got measles too and developed MS. The child regressed into autism and at this point he sent me the message that his wife was in the nursing home and he was bringing up the child. So glyphosate induces leaky gut due to the overgrowth of pathogens that goes to a leaky brain barrier and that allows the antibodies to get into the brain and destroy the myelin sheath.

(slide) Neurological disease really fascinated me. We were looking for glycine. (slide) We found in the Amyloid beta, the Amyloid beta is associated with Alzheimer's disease. It is a plaque that associated with Alzheimer's disease. It is these misfolded Proteins that gather in the brain and are linked to Alzheimer's. They have been trying to develop drugs that suppress Amyloid beta. That's just one example of a miscoded

protein. Parkinson's has a similar example which is Alpha synuclein, ALS has one that is TDP43, and I can never remember what TDP43 stands for; some complicated biological word, and in the prion diseases Mad Cow and that sort of thing, have these prion proteins. All of these are examples of proteins produced in the brain that misfold. They're not folding correctly, and then they can't be cleared so they build up this protein debris. And then these diseases are very strongly linked to these problems with these proteins. So on the right hand side you have the references and on the bottom they are spelled out in full. These four papers talk about in each of these cases, glycines in these molecules. These proteins that are misfolding have critical glycines they absolutely depend on to fold them correctly and to work correctly. They've actually zeroed in on the glycine as being the source of trouble for the disease. And they are not thinking of glyphosate but they should be. A conserved glycine in a protein means that it wants glycine there and it ought to work properly, but if the glycine is glyphosate instead it doesn't work anymore and then you get the trouble. The glyphosate makes it more soluble, makes it more resistant to be being broken down and it makes it not work correctly, and so you get into a real mess with these contaminated proteins building up and not being able to be cleared.

(slide) So that is the case with all of those papers. A very rare soluble peptide rather than the precipitated plaque is the source of trouble, and glyphosate would make a protein more soluble so that would be precipitated out. That would be better but it's these soluble ones that are causing the trouble in the disease process.

(slide) Here is a plot of death from senile dementia. Those are the yellow boxes and the red line is the glyphosate usage on corn and soy products, these two curves almost coincide. And so I think this is a very good explanation for what's causing it is this problem with glyphosate getting into amyloid beta protein. I think it would be very difficult to get it out once it gets in so as you slowly accumulate glyphosate in your body it is just going to keep piling up in your brain until at some point, it will be too much and you will get Alzheimer's and then you, it will be very difficult to reverse it at that point.

(slide) Here's a paper about autism and GABA. GABA is another one of these receptors in the brain. This one is inhibitory and autism has been linked by a weakened response of the GABA receptor. And this receptor has conserved glycine at the entrance to the first membrane spanning domain that is essential to its function. So again glycine and glyphosate and you get an inhibited GABA response which can be a factor in autism.

(slide) Diabetes, Obesity and Adrenalin deficiency

(slide) Is glyphosate making us all obese? I've been noticing that every time an undeveloped country starts switching to a Western diet, they start getting fat. It is pretty much around the world. People switch to a Western diet, they get fat. I think its glyphosate and I think there is a very simple reason that that would be true.

(slide) This looks like a fancy picture but I am not going to go into all the detail of all these pathways. I am just going to point out a few key pieces of this picture. This hormone sensitive lipase is also called Triacylglycerol Lipase, that's protein response to hormone such as adrenalin that are produced under certain circumstances and then in response to that it causes the release of three fatty acids from the fat stores. So this is a fat cell and when it gets the hormone on the membrane then this hormone sensitive lipase is going to kick in gear and release that fat and allow the cells to use that fat as fuel. So the adrenalin, you have a mechanic situation where you need some energy and you release the fat and you are all set to go. But if you have glyphosate disrupting that hormone then you don't release the fat and so what happens is your fat stores keep accumulating and you get fat because you can't get it out.

(slide) This same hormone is important for supplying cholesterol to the adrenalins and that cholesterol is used to make all those adrenalin hormones that are so important for regulating your homeostasis. And so the hormones are glucagone, adrenalin, dopamine and ACTH, These are all really important hormones that are produced to make everything go smoothly but if your lipase is insensitive to the hormone, it's just not going to work at all and you are going to have a major metabolic disorder including obesity. And also that you are going to have adrenalin insufficiency because of the problem of the role with this enzyme. And this enzyme depends on multiple conserved glycines. They contain an HGGG motif as "oxyanion hole" which is absolutely essential for its function and is a member of the class of "serine proteases" (all of which are affected by glyphosate) that contain a GXSXG motif, so it is glycine on each end of that and is essential for enzyme activity. So these are specific proteins where glycine plays a really important role. And so these impaired version of these, of this particular enzyme has been linked to obesity, atherosclerosis, and type 2 diabetes.

(slide) And so here is a plot in Nancy's paper that I mentioned earlier of glyphosate usage and death due to obesity. Again a similar story; we have a dramatic rise in the obesity and glyphosate and the GMO crops.

(slide) And this is interesting. It turns out that maternal obesity and maternal gestation diabetes are linked with Autism in the offspring (and Other Developmental Disabilities) and this is a study done in Boston on some close to 3,000 children. And the mothers who had obesity and pre-gestational Diabetes had a fourfold increased risk of having autism in their offspring, so in fact all of these match. (slide) Diabetes and obesity and autism all match very well with glyphosate usage on soy and corn crops. So there is adrenal insufficiency.

(Slide) There is a paper about Roundup that shows Roundup severely impairs adrenal hormones synthesis and so here is a possible mechanism for messing up this hormone sensitive lipase.

(Slide) Also diabetes and insulin receptor, that's absolutely another one that depends on glycine and so glucagon release is regulated by insulin receptors (IRs) in the liver.

When IRs are dysfunctional in mice, excess glucose is released from the liver, that is leading to elevated blood sugar and then to diabetes. And this thing has 8 repeats of a glycine-centered motif to make up its IR 3-D structure and it also has an ATP-binding site contains a GXGXXG (three glycine in it) motif. And so diabetes is strongly correlated with glyphosate - in the blue GMO crop and the yellow is the increase in the incidence of diabetes in this country.

(slide) Celiac disease is another one and Anthony and I have a paper on that one as well. The yellow box shows the rise of celiac disease or gluten intolerance in America and the black line is glyphosate usage on wheat. Not corn and soy but wheat. Wheat is a non-GMO which they spray with glyphosate right before the harvest. In fact some people have been measuring wheat products and finding high levels of glyphosate in them. So that is another one to worry about. You have the non-GMO Cheerios that General Mills was proud to introduce, non-GMO probably sprayed with glyphosate right before the harvest and probably a very nasty product that you don't want to eat even though it is non-GMO.

(slide) So Prolyl aminopeptidase is a very interesting protein that plays a critical role in processing wheat, gluten in particular. How you get to Prolyl aminopeptidase is because you can't break down gluten and gluten turns out to have a lot of proline and this enzyme (Prolyl aminopeptidase) specializes in breaking down the gluten in proline. Proline, it turns out to be difficult to break down and this enzyme Prolyl aminopeptidase, that breaks down proline-containing peptides, depends on manganese as a catalyst, but glyphosate makes manganese unavailable. And secondly it has a highly conserved GxSxGG motif, so three glycines in there, plus two other regions with conserved glycines. So three different regions of this enzyme depend on glycine. So any of those can be messed up by glyphosate and that would then cause celiac disease. Malabsorption due to celiac disease can lead to nutritional deficiencies and symptoms of autism. Lots of kids with autism have celiac issues. So I've said this already but this also includes sugar cane, barley, peanuts, maise, legumes are also treated with glyphosate sprayed right before the harvest. We have wheat allergy problems, gluten allergy problems, we have casein allergies in milk. Milk is produced by cows that are fed heavy doses of glyphosate. I think all of these allergies can be traced to glyphosate contaminating the protein in the product.

(slide) Now the fun part – how to safeguard your family. This is a picture of my kitchen table. In my household we are religious about buying only organic, certified organic food. Including beer and wine, the cornstarch here, spices. We're very, very careful to eat only organic when we go out - it's much harder. It's much harder when you eat out. But we always eat organic and would encourage you to do the same. Manganese is important and it is chelated by glyphosate to be deficient so these are some of the foods that contain manganese. Bread and soy which are difficult to get because they would be glyphosate contaminated. And seeds and mussels, seafood, tea, kale, spinach. (slide) These are good sources of manganese. Sulfur is another one that I have

identified as a problem with deficiencies so we try to get a lot of sulfur containing foods. We eat a lot in our household. Eggs are a great choice. We can get some really nice organic eggs. Buy top of the line eggs because those really have a lot of high micronutrients and again the seafood, the crabs, the shrimp, the cheese. I love cheese and you can get organic cheese, and meat and liver. It is very healthy except that it is all going to be poisoned by chemicals. You have to eat some animal that has had a very healthy lifestyle to get good liver, but it is a super nutrient food. Onions and garlic, use them all the time for the sulfur. And cabbage is a family of veggies that are a healthy form of sulfur; broccoli, cauliflower, Brussel sprouts etc.

(slide) Now this is really fun - extracts from Common Plants Can Treat Glyphosate Poisoning including dandelions; (you have to be careful they haven't been sprayed with glyphosate).

Roundup is toxic to hepatic and embryonic cells 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. This was a great article I found on cows treating glyphosate poison found in urine. They fed them activated charcoal, bentonite clay (these are things found in the soil), humic and fulvic acids, and sauerkraut juice (probiotics). These have been shown to be effective in reducing urinary levels of glyphosate and improving animal health. So these are good things to think about as far as detoxing is concerned.

(slide) These are some nutrients that I strongly recommend in general for health and we try to use them a lot in our cooking. Curcumin an Indian spice is really wonderful in curry. Garlic I mentioned. Eat a lot of sources of Vitamin C; that's a great anti-oxidant. Probiotics like sauerkraut and also yogurt. It is really important to work on fixing your gut. That's the food form of folate - Methyl tetrahydrofolate – you don't want to take folic acid. I've done a whole talk on that and a whole paper. That's actually added as a supplement, actually added as a fortification in wheat based products in the US and it is not a good idea, but Methyl tetrahydrofolate that you actually get naturally from folate containing foods is healthy. Cobalamin is B12. Glutathione contains sulfur but also a good anti-oxidant. Taurine is a sulfur containing amino acid. I've studied taurine and it has a lot of health benefits, in the heart and brain and liver and performs a very important role there. And an Epsom salt bath is my favorite thing. Just pour a hot bath, buy the Epsom salt easily at Whole Foods, pour it in the water. With magnesium sulfate, both are important nutrients and help restore the levels in your body.

(slide) Grassroots efforts: some things that are going on. California EPA moved to label glyphosate a "probable carcinogen" in response to the WHO information and of course they started to get a lot of lawsuits from the industry. Richmond, California banned glyphosate usage on public land and there are other cities doing the same. Now that's

something you can get involved with your local government. Especially in schools, get them not to use Roundup in schools. Tony Mitra, an activist in Canada, proposes that people should pressure the mayors of their municipalities into testing glyphosate levels in water and food products. It is woefully under tested everywhere. And I just have this one last picture – what's wrong with this picture?

To summarize: Glyphosate is the most damaging chemical in our environment today. We have been grossly misled into believing that it is non-toxic to humans. The strong correlations between glyphosate usage on core crops and the alarming rise in the incidence of a long list of diseases are supported by evidence of harm. Glyphosate's toxicity is easily explained by its biological mechanisms, particularly its potential ability to substitute for glycine during protein synthesis. If this is true I think it is a game changer. We are still working hard to get more proof because this is going to be a difficult path to get people to prove that this is true. I think there is a lot of circumstantial evidence that it is. Its effects are insidious and cumulative. Every time you eat it you may be adding a little more into your brain to lead you toward Alzheimer's disease. We need to switch to sustainable organic agriculture and ban glyphosate across the globe. Of course I would go further and say we need to go back to sustainable agriculture and ban all toxic chemicals that we are using in our crops and in our food and make food wholesome again.