Polluting Our Future

Chemical Pollution in the U.S. that Affects Child Development and Learning

National Environmental Trust
Physicians for Social Responsibility
Learning Disabilities Association of America

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The National Environmental Trust

With experience in public education, governmental affairs, federal environmental law, and investigative research, NET provides public policy expertise and educational outreach on national environmental issues.

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The Learning Disabilities Association of America

The Learning Disabilities Association is a national, non-profit, volunteer organization dedicated to enhancing the quality of life for all individuals with learning disabilities and their families, to alleviating the restricting effects of learning disabilities, and to supporting endeavors to determine the causes of learning disabilities.

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I. Executive Summary: Major Findings

Reported Emissions. U.S. companies reported to the Environmental Protection Agency that in 1998—the most recent year for which information is available — they released 1.2 billion pounds of chemicals into the nation's air and water that have the potential to affect the way a child's body and brain develops. More than half (53%) of all toxic chemical emissions reported to the federal Toxics Release Inventory are known or suspected developmental or neurological toxins.

Estimated Total Emissions. Emissions reported to the federal government account for only an estimated 5% of all chemical releases in the country. Using this estimate and assuming that—like for reported chemicals—approximately half of all emissions are known or suspected developmental or neurological toxins, total estimated releases of these substances to air and water could be as high as 24 billion pounds annually.

States with Highest Emissions. Louisiana and Texas lead the nation as the number one and two emitters of developmental and neurological toxins.

Largest Emitter. The chemical manufacturing industry is the single largest industrial source of developmental and neurological toxin emissions (to air and water) in the U.S. Paper, metal, and plastics manufacturers as well as electric power companies are also major emitters of these substances.

One Industry of Concern. The printing industry is the largest source of air emissions of toluene, a highly released developmental and neurological toxin. Since many printing facilities are small- to medium-sized firms, which are often closer to residential areas than other industrial facilities, this industry is potentially of major concern to child health.

Disproportionate Impacts on African Americans. Looking at the top 25 counties in the U.S. for releases of developmental toxins—where more than 46% of all reported developmental toxins were released—African American populations in 14 of 25 of the top releasing counties exceed the U.S. average. In other words, African Americans are over-represented in many of the counties most polluted by developmental toxins.

Increased Developmental and Neurological Effects. A growing number of scientists believe that developmental and neurological toxins could be partly responsible for the increased incidence of a range of physical and mental effects in children, including:

- A 6% increase over 8 years in very low birthweight babies born to young mothers having non-multiple births;
- A 4-1/2% increase over 8 years in premature babies born to young mothers having non-multiple births;
- A doubling of atrial septal defect (a hole in the wall between the chambers of the heart) over an 8-year period;

- A 50% increase in obstructive genito-urinary defects (blockage in the opening of the urinary tract) over 8 years;
- A probable increase in attention deficit hyperactivity disorder as measured by the explosive prescription rate of the drug Ritalin—even accounting for the possibility of overprescription (the number of children taking Ritalin has roughly doubled every 4 to 7 years since 1971); and
- An approximate doubling of the incidence of autism over 30 years.

Estimates of Children Affected. The U.S. Census Bureau estimates that 12 million U.S. children (17% of all children) suffer from one or more developmental, learning, or behavioral disabilities. The National Academy of Sciences recently estimated that about 3% of developmental and neurological defects in children are caused by exposure to known toxic substances—including drugs, cigarette smoke, and known developmental and neurological toxins like lead, PCBs, and mercury. This means that 360,000 U.S. children (1 in every 200 U.S. children) suffer from developmental or neurological deficits caused by exposure to known toxic substances.

Real Impacts are Likely Greater. The actual total impact of developmental and neurological toxins on U.S. children is probably greater than this statistic would suggest for two reasons: The National Academy of Sciences also concluded that an additional 25% of all developmental and neurological defects were caused by environmental factors working in combination with a genetic predisposition, and that toxic substances play an important but undetermined contributory role. Additionally, the 3% estimate includes only *known* developmental and neurological toxins. Since the overwhelming majority of the 80,000 chemicals in commerce has never been tested for developmental and neurological effects, the number of children affected by all developmental and neurological toxins is probably much higher.

Economic Costs. The estimated cost to our country, in medical and educational expenses and lost work and productivity, of just 18 of the most significant developmental defects is conservatively estimated to exceed $8 billion a year in aggregated lifetime costs. Using the National Academy of Sciences estimate that known toxic exposures cause about 3% of developmental and neurological disabilities, a range of toxic substances including developmental and neurological toxins are responsible for at least $240 million in annual lifetime costs for just 18 developmental disabilities. Once again, when considering the effects of the much larger number of unidentified developmental and neurological toxins in the environment, the National Academy's estimate that toxic chemicals play a contributory role in an additional 25% of developmental effects, and the fact that the above estimate covers just 18 disabilities, the actual economic toll of developmental and neurological toxins is probably much higher.

Recommended Policies. Because it has focused predominantly on cancer-causing substances, the regulatory system has not addressed the public health risk from developmental and neurological toxins. Effective policies to lower the risks from these substances include pre-market screening of new chemicals, mandatory testing of existing chemicals, product labeling, better pollution reporting, toxic chemical controls for electric power plants, and exposure and disease monitoring.

Note Regarding Usage: In this report, the word "toxin" is defined as a toxic chemical.

II. Introduction

The following report is the first ever to document the exact scope, nature, and sources of chemical pollution in the U.S. that is of specific concern for child development, learning, and behavior. Using industry data reported annually to the federal government, this report estimates total likely emissions of developmental and neurological toxins in the U.S., identifies geographical hotspots for reported emissions, and identifies the most polluting industries.

Understanding this kind of toxic pollution is important because an increasing number of scientists believe that developmental and neurological toxins are partly responsible for a range of physical and mental deficits in children. Such deficits include structural birth defects, mental retardation, autism, attention deficit hyperactivity disorder, and adverse birth outcomes such as low birthweight and prematurity.

In June 2000, a scientific panel convened by the National Academy of Sciences concluded that as many as 3% of known developmental and neurological deficits in children were caused by exposure to known toxic substances, including developmental and neurological toxins. The panel also concluded that 25% of these problems may be the result of environmental and genetic factors working in combination, and that toxic substances may play a significant but undetermined role *(see Section V. for a fuller discussion of the National Academy's conclusions)*.[1]

This report uses the National Academy of Sciences' highly conservative 3% estimate to approximate the contribution that known toxic substances could be making to the number of children afflicted with physical and mental disabilities.

The report also reviews a number of health-related statistics suggesting the possibility of increased incidence of some developmental and neurological conditions such as:

- Low birthweight births
- Premature births
- Atrial septal defects
- Genito-urinary defects
- Attention deficit hyperactivity disorder (ADHD)
- Autism.

Because children under one year of age are developing more rapidly, both physically and mentally, than at any other age, they are uniquely vulnerable to the effects of substances that can interfere with the biological systems that guide that development. Developmental and neurological toxins are likely of even greater concern to the developing fetus because of the even more rapid physical and brain development that occurs prenatally. For this reason, public health experts are generally concerned with toxic exposures to both children and pregnant women. This report identifies a number of public policy recommendations that could provide more protection for these sensitive populations.

A Different Way of Looking at Chemicals

A few years ago, the notion that exposure to toxic chemicals could affect the way people behave or how children develop might have seemed far fetched. The public has long understood how exposure to lead can interfere with children's learning or how pregnant women's exposure to mercury in fish could effect the neurological development of their baby. But most people would be surprised to learn that there are 278 other substances in the environment that have the potential to affect the way a child's brain and nervous system develop (neurotoxins), or that there are 45 other substances in the environment that have the potential to affect the way a child's body develops (developmental toxins).

The public, the government, and even scientific researchers have historically given neurotoxins and developmental toxins short shrift. The reason is simple: The public's longstanding and understandable concern with cancer and chemical carcinogens has commanded the attention of the media, government officials, and scientists.

It's perhaps not surprising that the vast majority of regulatory standards for allowable exposure to toxic substances consider only the risk of cancer. Even as our knowledge of these issues improves, regulations still ignore the greater vulnerability of developing children and fetuses to toxic exposures. New chemicals introduced into commerce still do not have to be shown safe for children's developing bodies and brains.

Ignorance Prevails

The U.S. Environmental Protection Agency (EPA) estimates that up to 28% of all chemicals in commerce could have the potential to be neurologically toxic.[2] Nevertheless, current information about exposure and potential harm is sharply limited for the overwhelming majority of neurological—and developmental—toxins emitted into the environment:

- Nearly 78% of the 3,000 most highly produced chemicals have no screening information available on developmental or neurological effects on children.[3]
- Tests for developmental neurotoxicity have been submitted to EPA for only 12 chemicals—nine pesticides and three solvents—as of December 1998.[4]
- Testing for developmental neurotoxicity is not routinely required in the registration of pesticides, one of the strictest areas of chemical regulation.

Some Current Environmental Exposures Already Deemed Dangerous

There is far too little toxicity and exposure information for the vast majority of developmental and neurological toxins to allow for determinations as to whether children or pregnant women are too highly exposed to specific substances. But there is clear evidence that children and pregnant women exceed recommended exposure levels even for the very few developmental and neurological toxins we know something about:

- According to EPA estimates, about 1.6 million women in the U.S. of childbearing years eat sufficient amounts of mercury-contaminated fish to risk damaging the brain development of their children. Forty states have issued one or more health advisories warning pregnant women or women of reproductive age to avoid or limit fish consumption. Ten states have issued advisories for every lake and river within the state's borders.[5]

- Prenatal exposure to PCBs at current environmental levels has the potential to affect brain development and cause permanent deficits.[6]
- One million children in the U.S. exceed the currently accepted threshold for blood lead level exposure that affects behavior and learning.
- Breakdown products of the recently banned pesticide chlorpyrifos (a neurotoxin) are present in the urine of 90% of children tested in a recent Minnesota study.[7]

Recent Attention to the Issue

This report comes during a year in which environmental factors in children's brain and body development have received an unusually large amount of attention. *(See Appendix A for a complete list of recent citations.)* The National Academy of Sciences has released two major reports, one focused on developmental toxins in June 2000 and the other on the neurotoxin mercury in July 2000. A *U.S. News and World Report* cover story reported on this issue in June. Physicians for Social Responsibility documented chemical risks to child development, learning, and behavior in a May 2000 report, and the Pew Environmental Health Commission published a report on birth defects and developmental effects and their potential association with environmental factors in November 1999.

This report has benefited from each of these publications. The organizations releasing this analysis hope the contribution before you will add to the public's understanding and that the unprecedented attention that developmental and neurological toxins have received during the last few months will continue.

III. Methodology

Sources of the Data

The data used in this report were obtained through the federal Toxics Release Inventory (TRI), a national database created by Congress in 1986 through the Emergency Planning and Community Right to Know Act. Currently, environmental releases of 632—or 1%—of the approximately 80,000 chemicals in commerce are required to be reported to the TRI from select industries. Chemicals required to be reported were selected by the U.S. EPA based on their high level of release or their potential to threaten human health or the environment.

Data analysts isolated emissions data for 296 known or suspected developmental and neurological toxins and then analyzed that data based on geographic location and source of emissions. This report considers only toxic releases to air and water as they are the media through which toxic pollution achieves its greatest dispersion. Air pollution, in particular, represents the most dangerous form of pollution due to its very wide dispersion. Toxic releases to land and underground injection were not included in this report.

Currently, releases of 45 known or suspected developmental toxins and 278 known or suspected neurotoxins must be reported each year to the TRI *(see Appendix B)*.

Developmental toxins are those substances that can produce detrimental effects during fetal development. These effects include structural abnormalities, functional abnormalities, growth retardation, or death of the fetus. The known or suspected developmental toxins included in this report were identified as such by the California Environmental Protection Agency, which is required by law to identify safe levels of exposure to this class of substances.[8]

Neurotoxins can cause adverse effects on the nervous system. The known or suspected neurotoxins included here were identified by Environmental Defense in its Scorecard analysis, which provides the only comprehensive listing of neurotoxins available.[9] The references used to compile the list of neurotoxins appear in Appendix C.

Substances have been added to these lists most typically based on observed effects in animals or information from incidental human exposure. Some substances have been included here for which the only information available about health effects concerns studies looking at high exposure levels. Unfortunately, low level exposure studies haven't been done for the overwhelming majority of the substances identified. Additionally almost none of the substances has been tested for their effects on the developing brain and nervous system of fetuses. In the absence of such information, there is no reason to assume these substances are safe at lower exposure levels—especially considering that "safe levels" for a range of substances have historically been revised downward as more sensitive studies have been conducted *(see the Box, "Historically Underestimating the Chemical Threat," right)*.

Historically Underestimating the Chemical Threat

The historical record reveals that what have been considered "safe levels" for known developmental and neurological toxins have been continuously revised downward as scientific knowledge improves. Today, discernable effects of mercury on language and memory have been identified at less than 3% of the toxic threshold for mercury identified 28 years ago. It turns out that the complex human brain is much more sensitive to neuro-toxic exposures than was previously understood. Recent research has shown that animal studies of lead, mercury, and PCBs each underestimated the levels of exposure that cause effects in humans by 100 to 10,000 times. This is especially troubling since many of our nation's regulatory standards are based on animal studies.[10]

Limits of the Data

It's Impossible to Determine Whether Total Emissions of Developmental and Neurological Toxins are Going Up or Down

Since the emissions of less than 1% of all chemicals in commerce must be reported to the Toxics Release Inventory (TRI) and some industries are exempt from reporting, there is no way to determine from publicly available data whether total emissions of developmental and neurological toxins into the environment are going up or down. Few of the 80,000 chemicals in commerce are required to be tested for their developmental or neurotoxic effects, and only 296 such chemicals are required to be reported to the TRI by some facilities. For this reason, the data analyzed in this report represent just the tip of a much larger iceberg. It is likely that additional thousands of substances in commerce and emitted into the environment have the potential to cause developmental or neurological effects in children.

Even for those chemicals reported to the TRI, it is impossible to know whether reported emissions have gone up or down. Facilities reporting their emissions since 1987 have seen a reduction of emissions of some chemicals into the environment—typically in response to public reporting requirements. But thousands of new facilities were first required to report their toxic emissions only in 1998, and the number of chemicals facilities were required to report roughly doubled in 1995. There is simply not enough information available to know whether those facilities that started reporting their emissions only last year have reduced their emissions over time.

The emissions of a limited number of developmental and neurological toxins from a limited number of reporting facilities have gone down since 1987. Nevertheless, this cannot be taken to mean that total emissions of these substances into the environment have gone down. Most developmental and neurological toxins are not reported and so industry is under no incentive to reduce their emissions. Furthermore, sharply increased chemical sales as well as economic growth over the last several years would suggest that total emissions of all toxic substances—including developmental and neurological toxins—have probably increased.

Children May be Exposed to Toxins other than Through Environmental Releases

It is also important to note that in addition to ambient environmental exposures, children and pregnant women may be exposed to developmental and neurological toxins through contact with everyday products and through their food:

- According to data from the Massachusetts Department of Environmental Protection, over half of the top twenty chemicals incorporated in products in Massachusetts are known or suspected neurotoxins.[11]
- More than 22% (by weight) of all pesticides used for agriculture have the potential for developmental toxicity.[12]
- Fifteen percent of the top nine pesticides used in homes could affect development.[13]

IV. Findings: Reported Emissions of Developmental and Neurological Toxins

Overview

In 1998 (the most recent year for which records are available), U.S. companies reported to the federal Toxics Release Inventory that they released slightly more than 1.2 billion pounds of chemicals that are classified as known or suspected developmental or neurological toxins into the nation's air and water. These are chemicals that have the potential to affect the way a fetus or a child's body and brain develops, substances that could cause premature and low birthweight births, birth defects, and learning and behavioral disabilities. More than half (53%) of all toxic chemical releases reported to the federal Toxics Release Inventory are known or suspected developmental toxins or neurotoxins.

Because fewer than 1% of chemicals in commerce require reporting of their emissions, the emissions reported to the government account for only an estimated 5% (by weight) of all chemical releases in the country.[14] Using this estimate and assuming that—like for reported chemicals—approximately half of all emissions are developmental or neurological toxins, total estimated releases of these substances to air and water could be as high as 24 billion pounds released annually.

The What, Where, Who, and Why of Developmental and Neurological Toxin Emissions

What

A total of 2.3 billion pounds of toxic air emissions and surface water discharges were reported by industry to the federal Toxics Release Inventory in 1998. Developmental and neurological toxins represent more than 53% of that total—or 1.2 billion pounds.

Table 1: Total Air and Water Releases of Developmental and Neurological Toxins, 1998

Chemical Category	Air Emissions and Surface Water Discharge (pounds)	Percent of All Chemical Releases to Air and Water*
Developmental Toxins	153,210,097	6.7
Neurotoxins	1,207,895,893	53.0
Chemicals That Are Developmental and Neurotoxins	153,138,267	6.7
TOTAL**	**1,207,967,723**	**53.00**

* 2,280,423,502 pounds of TRI chemicals were released to air and water in 1998

** Note that since some chemicals are both developmental and neurotoxins, the total has been adjusted to avoid double counting.

Source: U.S. EPA's Toxics Release Inventory, 1998

Of the top 20 chemicals reported by the Toxics Release Inventory as released into the environment in the largest quantities in 1998, nearly three-quarters are known or suspected developmental toxins or neurotoxins. The overwhelming majority of chemicals in use has never been tested for specific effects on the physical and brain development of children.

Table 2: Top 20 Chemicals Released to the Air and Water, 1998

Rank	Chemical Name	Air Emissions and Surface Water Discharges (pounds)	Neurotoxins (N) or Developmental Toxins (D)
1	Hydrochloric Acid (Aerosols)	589,566,802	
2	Methanol	195,841,453	N
3	Sulfuric Acid (Aerosols)	193,610,776	
4	Nitrate Compounds	172,547,789	
5	Ammonia	162,786,085	N
6	Toluene	98,178,314	N, D
7	Hydrogen Fluoride	80,362,323	N
8	Xylene (Mixed Isomers)	68,445,548	N
9	N-Hexane	66,710,074	N
10	Chlorine	60,260,970	N
11	Styrene	53,621,860	N
12	Methyl Ethyl Ketone	46,618,434	N
13	Carbon Disulfide	43,448,075	N, D
14	Dichloromethane	40,305,157	N
15	Certain Glycol Ethers	37,339,214	
16	Ethylene	30,711,082	N
17	Phosphoric Acid	28,943,730	N
18	N-Butylalcohol	21,514,719	
19	Carbonyl Sulfide	19,356,525	N
20	Propylene	16,450,334	
	Total Number of Developmental or Neurotoxins		**14**

14 out of 20 of the chemicals with the highest releases are developmental or neurotoxins, and account for 51 percent of releases of the top 20 released chemicals.

Source: U.S. EPA's Toxics Release Inventory, 1998

Where

Louisiana and Texas lead the nation in the air and water emissions of developmental and neurological toxins, with most of the pollution in those states coming from chemical manufacturing, petroleum refining, and paper manufacturing. Following Louisiana and Texas as the leading states with the highest air and water emissions of developmental and neurological toxins are Tennessee, Utah, Ohio, Alabama, Indiana, and Illinois. *(See supplemental state material for specific data on each state.)*

Table 3: State Rankings for Releases of Developmental and Neurological Toxins

State	Air Emissions and Surface Water Discharges (pounds)	Rank	Air Emissions (pounds)	Rank	Surface Water Discharges	Rank
Louisiana	97,857,261	1	68,509,123	3	29,348,138	1
Texas	97,026,301	2	95,464,784	1	1,561,517	3
Tennessee	72,224,000	3	71,294,718	2	929,282	8
Utah	58,720,668	4	58,694,707	4	25,961	42
Ohio	58,339,432	5	56,882,318	5	1,457,114	4
Alabama	55,266,337	6	53,286,796	6	1,979,541	2
Indiana	49,752,246	7	49,417,845	7	334,401	25
Illinois	49,315,046	8	49,159,209	8	155,837	30
Georgia	45,536,532	9	44,708,316	9	828,216	11
North Carolina	42,542,298	10	41,094,735	10	1,447,563	5
Virginia	41,215,018	11	40,617,010	11	598,008	17
South Carolina	41,113,290	12	40,259,673	12	853,617	9
Michigan	39,136,939	13	38,722,120	13	414,819	22
Pennsylvania	35,890,928	14	35,434,907	14	456,021	21
Florida	34,097,585	15	33,244,932	15	852,653	10
Mississippi	33,938,981	16	33,182,774	16	756,207	12
Kentucky	29,454,913	17	28,772,908	17	682,005	14
Missouri	27,741,941	18	27,215,768	18	526,173	18
Arkansas	24,393,339	19	23,755,711	19	637,628	16
California	24,347,098	20	22,969,08	21	1,378,014	6
Iowa	23,661,335	21	23,418,680	20	242,655	27
Washington	20,507,413	22	19,144,165	22	1,363,248	7
Wisconsin	19,425,777	23	19,052,439	23	373,338	23
Kansas	18,888,494	24	18,820,210	24	68,284	37
Oklahoma	17,046,525	25	16,929,353	25	117,172	32
New York	16,196,638	26	15,692,896	26	503,742	20
Oregon	15,868,115	27	15,575,137	27	292,978	26
Minnesota	14,775,164	28	14,602,898	28	172,266	28
West Virginia	14,371,659	29	13,728,489	29	643,170	15
New Jersey	8,802,802	30	8,277,908	30	524,894	19
Maryland	8,339,082	31	7,980,543	31	358,539	24
Nebraska	7,100,650	32	6,934,795	33	165,855	29
Massachusetts	6,998,417	33	6,986,315	32	12,102	44
Puerto Rico	6,963,676	34	6,811,915	34	151,761	31
Idaho	5,933,057	35	5,880,167	35	52,890	38
Maine	5,497,988	36	4,810,145	36	687,843	13
Connecticut	4,365,370	37	4,248,452	37	116,918	33
Montana	4,276,728	38	4,183,771	38	92,957	35
Arizona	3,727,392	39	3,722,638	39	4,754	47
Colorado	3,386,120	40	3,352,220	40	33,900	40
Nevada	3,365,154	41	3,342,846	41	22,308	43
North Dakota	2,761,041	42	2,729,781	42	31,260	41
Alaska	2,450,657	43	2,399,994	44	50,663	39
Delaware	2,449,991	44	2,375,935	45	74,056	36
South Dakota	2,430,839	45	2,426,883	43	3,956	48
Wyoming	2,377,010	46	2,366,399	46	10,611	46
New Hampshire	2,239,264	47	2,123,496	47	115,768	34
Rhode Island	1,830,082	48	1,828,380	48	1,702	50
New Mexico	1,503,608	49	1,502,472	49	1,136	51
Hawaii	248,785	50	246,728	50	2,057	49
Vermont	196,271	51	184,897	51	11,374	45
District of Columbia	2,706	52	2,700	52	6	52

Source: U.S. EPA's Toxics Release Inventory, 1998

The top counties in the U.S. for releases of developmental and neurological toxins closely track the state rankings. The top releasing county in the U.S. is Tooele County, Utah. Utah is ranked as the fourth highest releasing state and has only one county in the top 100. Louisiana has nine counties in the top 100 and Texas has eight.

Table 4: Top 100 Counties for Releases of Developmental and Neurological Toxins, 1998

Rank	State	County	Air Emissions and Surface Water Discharges (pounds)	Number of Facilities	Rank	State	County	Air Emissions and Surface Water Discharges (pounds)	Number of Facilities
1	UT	Tooele	55,186,528	8	51	LA	Beauregard	3,635,632	2
2	LA	Ascension	37,626,245	17	52	TN	Sullivan	3,584,132	13
3	TX	Harris	21,182,347	245	53	LA	De Soto	3,577,409	6
4	TN	Hamblen	18,714,220	15	54	IA	Lee	3,548,802	13
5	AL	Mobile	15,607,112	46	55	OK	McCurtain	3,415,374	3
6	LA	St. James	15,482,909	7	56	TX	Nueces	3,351,335	17
7	TX	Jefferson	13,349,501	44	57	MO	Carter	3,294,720	1
8	TN	Shelby	9,458,292	60	58	MS	Lee	3,256,570	16
9	IL	Cook	7,768,691	376	59	OK	Rogers	3,237,693	15
10	VA	Hopewell City	7,723,348	8	60	MI	Oakland	3,181,527	58
11	LA	East Baton Rouge	7,695,826	20	61	WA	Spokane	3,151,331	19
12	IL	Macon	7,390,835	17	62	KY	Marshall	3,089,802	14
13	KY	Jefferson	6,881,813	71	63	MS	Jackson	3,070,491	13
14	TX	Brazoria	6,736,308	29	64	IN	Tippecanoe	2,984,807	16
15	CA	Los Angeles	6,638,622	376	65	NY	Erie	2,982,796	62
16	IN	Elkhart	6,378,372	88	66	AR	Mississippi	2,853,895	17
17	SC	Hampton	6,226,317	5	67	LA	Iberville	2,850,924	17
18	OH	Washington	6,139,024	16	68	NC	Columbus	2,850,600	6
19	IN	Lake	5,807,749	48	69	MO	St. Louis	2,784,623	56
20	TX	Galveston	5,726,526	16	70	KS	Wyandotte	2,758,929	29
21	OH	Ashtabula	5,567,863	27	71	SC	Charleston	2,753,664	21
22	LA	Calcasieu	5,539,152	28	72	MO	Shannon	2,753,280	1
23	TN	Humphreys	5,318,059	8	73	SC	York	2,739,442	16
24	IL	Vermilion	5,165,498	13	74	SC	Spartanburg	2,733,735	41
25	TX	Orange	5,155,296	11	75	LA	St. Charles	2,725,448	19
26	SC	Richland	5,123,695	18	76	TN	Loudon	2,722,493	8
27	OH	Allen	5,115,161	21	77	CA	Contra Costa	2,721,916	42
28	MI	Ottawa	4,895,162	38	78	TX	Gregg	2,664,966	17
29	MI	Wayne	4,612,708	134	79	FL	Polk	2,623,591	37
30	WI	Wood	4,547,565	17	80	TX	Ector	2,596,576	12
31	VA	Richmond City	4,528,516	19	81	GA	Decatur	2,582,200	3
32	GA	Richmond	4,479,753	24	82	OH	Union	2,581,817	4
33	SC	Georgetown	4,296,305	5	83	OH	Cuyahoga	2,579,020	154
34	MS	Warren	4,175,285	8	84	FL	Hillsborough	2,575,255	42
35	AL	Russell	4,150,107	7	85	FL	Putnam	2,566,202	8
36	AL	Jefferson	4,131,311	68	86	MO	Clay	2,559,962	15
37	WA	Cowlitz	4,101,234	9	87	FL	Nassau	2,532,764	3
38	FL	Escambia	4,090,571	9	88	MI	St. Clair	2,503,944	14
39	MI	Monroe	4,049,007	9	89	LA	Ouachita	2,498,153	7
40	GA	Chatham	4,024,801	21	90	MD	Baltimore City	2,490,341	37
41	VA	Alleghany	3,983,297	5	91	PA	Allegheny	2,442,375	76
42	AL	Morgan	3,872,353	21	92	WV	Marshalla	2,410,442	6
43	PA	Erie	3,802,595	47	93	PA	Berks	2,407,110	53
44	TN	McNairy	3,797,941	5	94	KS	Ford	2,396,935	7
45	NC	Catawba	3,783,612	40	95	OR	Lane	2,383,416	21
46	MS	Lowndes	3,758,436	11	96	IA	Woodbury	2,378,137	17
47	KS	Sedgwick	3,745,538	35	97	TN	Hardin	2,372,802	3
48	IA	Clinton	3,725,804	10	98	TN	Dickson	2,362,305	10
49	NY	Monroe	3,717,271	31	99	IL	Jo Daviess	2,356,736	4
50	MI	Kent	3,686,988	70	100	GA	Early	2,354,651	1

Source: U.S. EPA's Toxics Release Inventory, 1998

Who

The chemical manufacturing industry is the single largest industrial source of developmental and neurological toxin emissions (to air and water) in the U.S. Other industries that contribute substantial quantities of developmental and neurological toxin emissions are the paper, primary metal, plastics, transportation equipment, and electric power-generating industries.

The printing industry is the largest source of air emissions of toluene, a highly released developmental and neurological toxin. Since many printing facilities are small- to medium-sized firms that are often closer to residential areas than other industrial facilities, this industry is potentially of major concern to child health.

Table 5: Top Industries for Air and Water Releases of Developmental and Neurological Toxins, 1998

Rank for Developmental and Neurotoxins	Industry	Air Emissions and Surface Water Discharges (pounds)		Rank for All Reported Chemicals
		Developmental and Neurotoxins	All Reported Chemicals	
1	Chemicals and Allied Products	329,852,556	428,151,782	2
2	Paper and Allied Products	187,553,811	234,389,344	3
3	Primary Metal Industries	107,733,441	181,051,920	4
4	Rubber and Miscellaneous Plastics Products	105,272,479	111,032,279	5
5	Electric Utilities	78,312,416	787,890,919	1
6	Transportation Equipment	78,035,222	94,648,012	6
7	Food and Kindred Products	61,144,420	90,176,216	7
8	Petroleum Refining and Related Industries	51,258,661	75,601,502	8
9	Fabricated Metal Products	33,801,646	65,065,276	9
10	Lumber and Wood Products, Except Furniture	32,263,591	33,704,524	11
11	Stone, Clay, Glass, and Concrete Products	29,334,102	39,558,359	10
12	Printing, Publishing, and Allied Industries	21,537,525	22,619,138	12
13	Furniture and Fixtures	15,201,167	17,900,328	14
14	Electronic and Other Electric Equipment	14,950,300	20,762,417	13
15	Machinery, Except Electrical	14,748,792	17,000,496	15
16	Textile Mill Products	11,090,370	11,838,463	17
17	Miscellaneous Manufacturing Industries	9,253,778	9,744,804	18
18	Instruments and Related Products	7,991,001	12,317,128	16
19	Petroleum Terminals	4,393,608	4,427,240	21
20	Metal Mining, except Iron Ores and Uranium	3,215,941	4,749,413	19
21	Other Industries	2,157,319	4,477,584	20
22	Tobacco Manufacturers	2,130,544	3,326,579	22
23	National Security and International Affairs	1,470,608	1,794,630	24
24	Leather and Leather Products	1,469,780	2,625,526	23
25	Chemical Distributors	1,224,302	1,308,910	26
26	Solvent Recyclers	814,866	825,986	28
27	Coal Mining, except Extraction Activities	745,047	1,763,941	25
28	Apparel and Other Finished Fabric Products	524,265	531,212	29
29	RCRA Regulated Treatment, Disposal, or Recycling Sites	486,165	1,139,574	27

Source: U.S. EPA's Toxics Release Inventory, 1998

Table 6: Top Facilities for Air and Water Releases of Developmental and Neurological Toxins, 1998

Rank	Facility Name	City	State	Industry
1	Magnesium Corp. of America	Rowley	UT	Primary Metal Industries
2	PCS Nitrogen Fertilizer L.P.	Geismar	LA	Chemicals and Allied Products
3	Lenzing Fibers Corp.	Lowland	TN	Chemicals and Allied Products
4	IMC-Agrico Co. Faustina Plant	Saint James	LA	Chemicals and Allied Products
5	Acordis Cellulosic Fibers Inc.	Axis	AL	Chemicals and Allied Products
6	International Paper	Hampton	SC	Rubber and Miscellaneous Plastics Products
7	CF Inds. Inc.	Donaldsonville	LA	Chemicals and Allied Products
8	Alliedsignal Inc. Hopewell Plant	Hopewell	VA	Chemicals and Allied Products
9	PCS Nitrogen Fertilizer L.P.	Millington	TN	Chemicals and Allied Products
10	Elkem Metals Co.	Marietta	OH	Primary Metal Industries
11	Aguaglass Corp.	Adamsville	TN	Rubber and Miscellaneous Plastics Products
12	Devro-Teepak Inc.	Danville	IL	Rubber and Miscellaneous Plastics Products
13	Millennium Inorganic Chemicals Inc. - Plt 2	Ashtabula	OH	Chemicals and Allied Products
14	Boise Cascade Corp.	Deridder	LA	Paper and Allied Products
15	Westvaco Corp. Bleached Board Div.	Covington	VA	Paper and Allied Products
16	ADM Bioproducts	Decatur	IL	Chemicals and Allied Products
17	Triad Nitrogen Inc.	Donaldsonville	LA	Chemicals and Allied Products
18	International Paper	Mansfield	LA	Paper and Allied Products
19	PCS Nitrogen of Ohio L.P.	Lima	OH	Chemicals and Allied Products
20	Royal Oak Ent. Inc., Ellsinore Mo.	Ellsinore	MO	Chemicals and Allied Products

Source: U.S. EPA's Toxics Release Inventory, 1998

Why

The top developmental and neurological toxins are used in common industrial processes. Only three substances account for 97% of all pollution from developmental toxins. The toxins with the highest releases were toluene (a common degreaser and solvent, linked to fetal toxicity), carbon disulfide (used to manufacture synthetic fibers, linked to fetal toxicity), and benzene (widely used in manufacturing and as a component in gasoline, linked to developmental delays).

Table 7: Top 20 Developmental Toxins* Released to Air and Water (of 45 total), 1998

Rank	Chemical Name	Air Emissions and Surface Water Discharges (pounds)
1	Toluene	98,178,314
2	Carbon Disulfide	43,448,075
3	Benzene	7,694,967
4	Bromomethane	1,559,158
5	2-Methoxyethanol	1,028,695
6	Ethylene Oxide	614,777
7	Cyclohexanol	300,955
8	Epichlorohydrin	198,623
9	2-Ethoxyethanol	88,766
10	Sodium Dimethyldithiocarbamate	26,799
11	Potassium	25,260
12	Dimethyldithiocarbamate	10,051
13	1,2-Dibromoethane	7,552
14	Lithium Carbonate	6,578
15	Metham Sodium	4,864
16	Nabam	2,182
17	2,4-Dinitrotoluene	2,123
18	Ethyl Dipropylthiocarbamate	1,566
19	Bromoxynil Octanoate	1,439
20	Urethane	1,160

* The known or suspected developmental toxins included in this report were identified by the California Environmental Protection Agency (http://www.oehha.ca.gov/prop65.html).

Source: U.S. EPA's Toxics Release Inventory, 1998

The most released neurotoxins were methanol (used in paper manufacturing, linked to nerve damage and blindness), ammonia (used in much chemical manufacturing, linked to memory loss), toluene (linked to confusion, memory loss, and other neurological effects at both high and low levels), hydrogen fluoride (used in manufacturing and as a cleaner, linked to nerve damage), xylene (used as a solvent and cleaning agent, linked to impaired memory and muscle coordination) and n-hexane (industrial solvent, also used to refine vegetable oil, linked to nerve damage).

Table 8: Top 20 Neurotoxins* Released to Air and Water (of 278 total), 1998

Rank	Chemical Name	Air Emissions and Surface Water Discharges (pounds)
1	Methanol	195,841,453
2	Ammonia	162,786,085
3	Toluene	98,178,314
4	Hydrogen Fluoride	80,362,323
5	Xylene (Mixed Isomers)	68,445,548
6	N-Hexane	66,710,074
7	Chlorine	60,260,970
8	Styrene	53,621,860
9	Methyl Ethyl Ketone	46,618,434
10	Carbon Disulfide	43,448,075
11	Dichloromethane	40,305,157
12	Ethylene	30,711,082
13	Phosphoric Acid	28,943,730
14	Carbonyl Sulfide	19,356,525
15	Methyl Isobutyl Ketone	14,889,643
16	Formaldehyde	13,684,275
17	Trichloroethylene	13,094,813
18	Acetaldehyde	12,795,587
19	Phenol	8,965,671
20	Chlorodifluoromethane	8,953,324

* The known or suspected neurotoxins included in this report were identified by Environmental Defense in its Scorecard anaylsis. The references used to compile the complete list of neurotoxins appear in Appendix C.

Source: U.S. EPA's Toxics Release Inventory, 1998

Potentially Disproportionate Impacts on African American Children

Children from minority or low-income communities are typically at greater risk of exposure to toxic substances. African American, Hispanic, and Native American children are over-represented in the three to four million children (one out of every four American children) who live within one mile of a National Priorities List hazardous waste site. A number of studies have demonstrated increased levels of premature births in communities that are proximate to hazardous waste sites or facilities.[15] Several studies have confirmed racial disparities in the citing of industrial and hazardous waste facilities.

Beyond these statistics, children from low-income neighborhoods and living in poorly maintained housing, for example, have a higher level of exposure to lead from flaking lead-based paint. Moreover, many children who attend dilapidated schools or live in distressed housing often find themselves in pest-ridden environments where chemical pesticides are frequently applied.
An analysis of the top counties in the U.S. for releases of developmental toxins also reveals a

disproportionate impact on a minority group—in this case African Americans. Since emissions of neurotoxins are much more pervasive than those of developmental toxins, this analysis focused on the top 25 counties for releases of developmental toxins. Because that group of counties was responsible for the release of 46% of all the reported developmental toxins in the country, looking at the top counties provides a meaningful snapshot of where a significant proportion of this class of toxins is released.

This analysis reveals that African American populations in 14 of 25 of the top releasing counties exceed the U.S. average. In other words, African Americans are over-represented in many of the counties most polluted by developmental toxins.[16]

Table 9: Top 25 Counties for Air Emissions of Developmental Toxins and African American Population Figures

		African American Population	
State	**County**	**Number**	**Percent**
AL	Mobile County	117,816	30.83
CA	Los Angeles County	990,406	8.14
IL	Cook County	1,314,859	22.74
KS	Shawnee County	13,044	7.75
KY	Jefferson County	113,280	16.94
LA	Calcasieu Parish	38,519	22.64
MI	Kent County	40,004	7.78
MI	St. Clair County	2,934	1.98
MI	Wayne County	848,896	39.30
MO	St. Louis County	139,044	13.86
NJ	Middlesex County	52,901	7.25
NY	Erie County	09,668	11.08
NY	Orange County	22,244	6.76
NC	Catawba County	10,673	8.96
PA	Bucks County	15,053	2.74
PA	Chester County	23,911	6.22
PA	Lancaster County	9,571	2.19
SC	Richland County	119,411	41.14
SC	Spartanburg County	46,878	20.53
TN	Shelby County	360,343	43.26
TN	Sumner County	5,381	5.19
TX	Dallas County	369,883	17.12
TX	Harris County	540,404	15.65
TX	Jefferson County	74,434	29.57
VA	Henrico County	43,919	19.95
	United States	**29,930,524**	**11.06**

Source: 1998 Census Projections, Geolytics Corp.

V. Developmental and Neurological Effects in Children—Incidence and Potential Trends

Health Effects Incidence and the Role of Toxic Exposure

While the National Academy of Sciences attributes approximately 3% of developmental and neurological deficits to exposure to a range of toxic substances—including developmental and neurological toxins—the Academy also concludes that environmental factors—which include toxic substances—can cause approximately 25% of all developmental and neurological deficits working in combination with a genetic predisposition.[17]

Both of the National Academy panel's estimates should be considered conservative:

- The 3% estimate was only for *known and identified* toxic substances such as cigarette smoke, drugs, and toxic chemicals like PCBs, lead, and mercury. When considering the thousands of substances in commerce that are still as yet unidentified developmental and neurological toxins, a more realistic estimate of the actual role of developmental and neurological toxins in causing developmental and neurological deficits would have to be higher.
- In its estimate that environmental triggers working together with a genetic predisposition can cause approximately 25% of developmental and neurological deficits, the Academy is only referring to well recognized and clinically diagnosed mental and physical disabilities. There is a strong possibility—widely recognized among epidemiologists—that there may be many subtle mental and physical deficits that have not been diagnosed yet and are, therefore, not captured in this estimate.

Even though the National Academy's 3% estimate probably vastly underestimates the role of all developmental and neurological toxins in contributing to all developmental and neurological deficits, it is the only firm and authoritative estimate available to calculate a rough approximation of the role that known toxic substances may play in contributing to clinically diagnosed disabilities:

> The Census Bureau estimates that nearly 12 million U.S. children under 18 (17% of children) suffer from one or more developmental, learning, or behavioral disabilities.[18] If, according to the National Academy of Sciences, known toxic exposures are directly implicated in approximately 3% of these disabilities, then 360,000 U.S. children—or 1 in every 200 children—suffer from developmental or neurological defects caused by exposure to known toxic substances including developmental and neurological toxins.

Once again, considering the fact that 25% of all deficits have an undetermined environmental component and that we have not considered the number of unidentified toxins or undiagnosed deficits, the above estimate is likely to be highly conservative.

Possible Upward Trends in Developmental and Neurological Effects

With the increased production and use of developmental and neurological toxins over the last several decades, one would expect to see an increased incidence of developmental and neurological effects in U.S. children. In fact, this is exactly what we may be seeing.[20]

The developmental and neurological conditions discussed below are the only ones for which some statistical data has been gathered. In each case, there is statistical evidence for increases in incidence. Whether other conditions are on the increase is unclear because statistics are not collected for the vast majority of developmental, learning, and behavioral conditions. While toxic exposures have been clearly associated with a wide range of developmental and neurological effects, there are very little data that allow for an accurate assessment of the specific role that toxins play in the incidence of specific developmental and neurological deficits in U.S. children.

Low Birthweight and Premature Births

Exposure to a number of environmental agents, such as solvents, pesticides, lead, PCBs, benzene, carbon tetrachloride, and toluene, have been found to have negative impacts on birthweight. While fewer toxic substances have been directly implicated in causing premature births, [21] a number of studies have demonstrated increased levels of premature births in communities located near hazardous waste sites or facilities.[22]

Low birthweight and premature births have been rising steadily since the mid-1980s among a range of ethnic and maternal age groups. This has occurred despite increased prevention efforts. Low birthweight and age of gestation still provide the best predictive indicators of the risk of several major permanent developmental or neurological impairments, such as cerebral palsy and mental retardation. They are also strongly associated with Sudden Infant Death Syndrome, infant mortality in general, a range of infections, and other major disabilities.

- From 1990-1997, very low birth weight babies increased by 6% for white mothers aged 20-34 having single births.[23]
- Premature babies increased 4.6% among the same group during a similar time range.[24]

Structural Birth Defects

Birth defects are the leading cause of infant mortality in the U.S., causing about 70% of all neonatal deaths (before 1 month of age) and about 22% of the 6,000 deaths of infants (less than 12 months of age).[25] While about 20% of birth defects have known causes, the causes of 80% of all birth defects are unknown.

Evidence is mounting that environmental factors play an important role in contributing to the incidence of birth defects and developmental disorders. In addition to the conclusions of the National Academy of Sciences, the Pew Environmental Health Commission lists more than a dozen studies linking a range of toxic substances in the environment with structural birth defects.[26]

Few states keep adequate records that would allow for meaningful conclusions about birth defect trends. Nevertheless, some trends have been substantiated across a large number of states:

- The number of infants born with atrial septal defect (a hole in the wall between the two chambers of the heart) rose 2-1/2 times over an eight-year period (1989-1996). Part of this dramatic increase may be due to increased diagnosis and part to increased incidence. Without additional data over a longer period of time, it will be difficult to make specific determinations.[27]

- The number of infants born with obstructive genito-urinary defects (complete or partial blockage in the opening of the urinary tract) increased 1.6 times over eight years (1990-1997). Once again, more information will be needed to determine specific causes of the increase.[28]

For more information about additional increases of specific birth defects recorded in individual states or regions of the country, see "Healthy from the Start," Pew Environmental Health Commission, November 1999 (http://pewenvirohealth.jhsph.edu/html/reports/menu.html).

Behavioral and Learning Disorders

Animal studies and some human studies show that exposure to some organic solvents as well as dioxins and PCBs during development can cause hyperactivity, attention deficits, reduced IQ, and learning and memory deficiencies. Exposures to common chemicals like toluene, trichloroethylene, xylene, styrene, and manganese during pregnancy can cause learning and behavioral deficiencies in offspring.

Many researchers believe they are seeing an epidemic of learning and behavioral disabilities among children. Upward trends—often reported anecdotally by teachers and child care providers—may be attributed to real increases, improved detection, or improved reporting. Most researchers believe they are likely the result of some combination of the three. Still, only limited quantitative information is available about these types of health problems:

- The number of children in special education programs classified with learning disabilities increased 191% from 1977 to 1994.[29]
- One study showed a doubling of autism prevalence between 1966 and 1997. Statistics kept within the state of California roughly track that result with a 210% increase in the number of children receiving services for autism.[30]
- Attention deficit hyperactivity disorder (ADHD) is conservatively estimated to affect 3 to 6% of all school children. Some recent evidence suggests that the prevalence may be as high as 17%.[32]

A National Success Story: Reducing Exposure to the Neurotoxin Lead

The elimination of lead from gasoline and paint may be one of the most significant public health and educational advances of the 20th century. Research now equates a 10-point drop in blood lead levels with an average 2.8-point gain in IQ. Since the elimination of lead from gasoline in the U.S., we have witnessed a 15-point drop in mean blood lead levels. This gives every baby born today a gift of an average of four to five additional IQ points. What is that worth economically? In the U.S., conservative calculations suggest that each IQ point is worth about $8,300 in additional lifetime income, which would mean that the 15-point drop in blood lead levels is worth an average of $30,000 in income to each baby born. On a national level, with approximately 4 million babies born every year, the elimination of lead has an economic value of over $100 billion per year for the lifetime income of those children.[31]

- The number of children taking the drug Ritalin for ADHD has roughly doubled every 4-7 years since 1971, reaching its current use of about 1.5 million children.[33]

Additional indications that real increases of behavioral and learning deficits are occurring come from teachers and child care providers who dispute the notion that all increases are the result of better detection or rising expectations. Many professionals who are closest to the problem doubt that disabilities of such magnitude could have escaped notice in the past.

For more information about national trends in behavioral and learning disorders, see "In Harm's Way: Toxic Threats to Child Development," Greater Boston Physicians for Social Responsibility, May 2000 (http://www.igc.org/psr/).

How Much Developmental and Neurological Toxin Pollution Costs Society

Families whose children face even mild physical or mental deficits typically encounter substantial emotional and financial pressures. Studies conducted by the United Cerebral Palsy Association found that average annual expenses for families with children with cerebral palsy reached as high as $10,000 per year.[34]

What's less obvious is the dramatic impact that such deficits can have on society. Developmental, learning, and behavioral disabilities are associated with early dropout from school, substance abuse, unemployment, teen parenting, welfare dependence, and incarceration. Considering only direct costs of medical, developmental, and special education services and the costs of lost work and productivity, the combined estimated cost to the nation of just 18 of the most significant developmental defects in the U.S. is conservatively estimated to exceed $8 billion.[35]

Using the National Academy of Sciences estimate that known toxic exposures cause about 3% of known developmental and neurological deficits, a range of toxic substances, including developmental and neurological toxins, are probably responsible for $240 million in aggregated annual costs for only 18 developmental disabilities. This figure is highly conservative because it ignores the undetermined contributions that the National Academy says toxic exposures make in an additional 25% of disabilities. Additionally, this estimate does not include costs for several important learning and behavioral deficits including mental retardation, autism, and attention deficit hyperactivity disorder. Furthermore, costs have not been estimated for many of the more subtle developmental, learning, and behavioral deficits that may remain undiagnosed.

VI. Recommendations

There are no national, state or local policies that effectively encourage chemical makers or users to study chemicals in commerce for their developmental or neurological effects in children. And virtually no policies exist to encourage them to find safer substitutes.

Even for those developmental and neurological toxins we know about, manufacturers are not required to inform parents that one or more substances in their hair dye, for example, has been associated with cardiac defects in children;[36] that substances in spot and paint removers have been associated with cleft defects and nervous system defects; [37] or that some household weed killers have been associated with low birthweight.[38]

Finally, there are very little data that would allow public health officials and experts to accurately assess the overall role that developmental and neurological toxins play in the incidence of birth defects and learning and behavioral deficits in U.S. children. While the Centers for Disease Control (CDC) is explicitly funded to monitor substances related to nutrition in the bodies of our children, surprisingly the CDC does not receive funding to monitor for substances—like developmental and neurological toxins—that could cause, in some cases, life-threatening deficits. Because of the lack of federal funds available for this, few states collect meaningful data on the incidence of developmental or neurological effects.

The National Environmental Trust, Physicians for Social Responsibility, and The Learning Disabilities Association recommend the following policies be adopted to address the risk to children from developmental and neurological toxins:

Pre-Market Screening of New Chemicals. New chemicals should be tested and found to have no effect or potential effect on the physical or brain development of children before they are allowed into commerce. The existing law does not require testing for developmental and neurological effects.

Mandatory Testing of Existing Chemicals. Chemicals produced in high volumes, to which children and childbearing adults are routinely exposed, should be thoroughly tested for safety. The chemical industry has vigorously resisted an initiative that would have them voluntarily test such chemicals.

Labeling at the Point of Exposure. For substances currently in commerce that may potentially have developmental or neurological effects, all users and manufacturers should be required to post warning labels on products and near facilities emitting these substances. As demonstrated in California under Proposition 65, the requirement to inform consumers of hazardous exposures has a double benefit. It empowers consumers to protect themselves while at the same time encouraging manufacturers to find safer substitutes.

Better Pollution Reporting. Millions of pounds of releases into the environment of developmental and neurological toxins are never reported to federal or state Toxics Release Inventories (TRIs) because they are manufactured or used at levels that are less than current reporting thresholds. As a result, companies have no incentive to reduce pollution of these chemicals as they have for hundreds of other chemicals they do report to state and federal TRIs. If reporting thresholds for developmental and neurological toxins were lowered, more information would become available to the public, and releases of these substances would likely be reduced over time.

Regulating Electric Power Plants for Air Pollution. The electric power industry is the nation's largest source of industrial air pollution that is not regulated for toxic chemical emissions. EPA should treat the electric power industry like other major industries and require it to adhere to specific limits on toxic air pollution—including developmental and neurological toxins such as mercury, toluene, benzene, hydrogen fluoride, and nickel.

Exposure and Disease Monitoring. To allow public health officials and environmental regulators to assess the real effects of toxic chemicals on U.S. children, a program should be implemented to: (1) monitor developmental and neurological toxins in the bodies of representative samplings of children and women, and (2) record the incidence of developmental and neurological disabilities in the general population.

Appendix A

Recent Attention to Developmental and Neurological Toxins: Where to Find More Information

The last few months have seen an unprecedented public focus on emerging links between environmental toxins and developmental, learning, and behavioral problems:

National Academy of Sciences on Mercury's Neurotoxicity, July 2000.
NAS study documents the neurological effects of mercury. (*Toxicological Effects of Methylmercury*, NAS, http://books.nap.edu/books/0309071402/html/index.html.)

National Academy of Sciences on Developmental Toxins, June 2000.
NAS study concludes that a combination of environmental factors and genes may account for up to 25% of all developmental, learning, and behavioral defects. (*Scientific Frontiers in Developmental Toxicology and Risk Assessment*, NAS, http://www.nap.edu/books/0309070864/html/.)

***U.S. News and World Report*, June 2000.**
Cover story documents new studies suggesting increased behavioral and learning disorders as well as a history of aggressive chemical industry lobbying to exempt questionable substances from regulation. ("Kids at Risk: Chemicals in the Environment Come under Scrutiny as the Number of Childhood Learning Problems Soar," *U.S. News and World Report*, June 19, 2000.)

Speech by Tim Wirth, President, United Nations Foundation, June 2000.
Speech before the National Academy of Sciences documents the importance of addressing environmental pollutants that affect child development and learning. (*Environment and Health: A Connection to the Current Debate*, June 20, 2000.)

Physicians for Social Responsibility, May 2000.
Report documents children's potential for exposure to substances in the environment that could affect their physical and brain development, and documents research studies indicating increased incidence of some developmental, learning, and behavioral disorders. (I*n Harm's Way: Toxic Threats to Child Development*, Greater Boston Physicians for Social Responsibility, http://www.igc.org/psr/.)

Pew Environmental Health Commission, November 1999.
Report documents incidence and tracking of birth defects and developmental effects and their potential association with environmental factors. (*Healthy from the Start: Why America Needs a Better System to Track and Understand Birth Defects and the Environment*, Pew Environmental Health Commission, http://www.pehc.jhsph.edu.)

Appendix B

Known or Suspected Developmental and Neurological Toxins Used in this Report

Chemical Name	Developmental Toxin (D) or Neurotoxin (N)
1,1,1-TRICHLOROETHANE	N
1,1,2,2-TETRACHLOROETHANE	N
1,1,2-TRICHLOROETHANE	N
1,1-DICHLORO-1-FLUOROETHANE	N
1,1-DIMETHYL HYDRAZINE	N
1,2,3-TRICHLOROPROPANE	N
1,2,4-TRICHLOROBENZENE	N
1,2,4-TRIMETHYLBENZENE	N
1,2-DIBROMOETHANE	D, N
1,2-DICHLOROBENZENE	N
1,2-DICHLOROETHANE	N
1,2-DICHLOROETHYLENE	N
1,2-DICHLOROPROPANE	N
1,3-BUTADIENE	N
1,3-DICHLOROPROPYLENE	N
1,4-DICHLORO-2-BUTENE	N
1,4-DICHLOROBENZENE	N
1,4-DIOXANE	N
2,4-D	N
2,4-D 2-ETHYLHEXYL ESTER	N
2,4-D BUTOXYETHYL ESTER	N
2,4-D BUTYL ESTER	N
2,4-D SODIUM SALT	N
2,4-DB	D
2,4-DIMETHYLPHENOL	N
2,4-DINITROPHENOL	N
2,4-DINITROTOLUENE	D, N
2,6-DINITROTOLUENE	D, N
2-ETHOXYETHANOL	D, N
2-MERCAPTOBENZOTHIAZOLE	N
2-METHOXYETHANOL	D, N
2-METHYLLACTONITRILE	N
2-METHYLPYRIDINE	N
2-NITROPHENOL	N
2-NITROPROPANE	N
2-PHENYLPHENOL	N
4,4'-ISOPROPYLIDENEDIPHENOL	N

Chemical Name	Developmental Toxin (D) or Neurotoxin (N)
4,4'-METHYLENEBIS(2-CHLOROANILINE)	N
4,4'-METHYLENEDIANILINE	N
4,6-DINITRO-O-CRESOL	N
4-AMINOBIPHENYL	N
4-NITROPHENOL	N
ACEPHATE	N
ACETALDEHYDE	N
ACETONE	N
ACETONITRILE	N
ACROLEIN	N
ACRYLAMIDE	N
ACRYLONITRILE	N
ALDICARB	N
ALDRIN	N
ALLYL ALCOHOL	N
ALLYL CHLORIDE	N
ALUMINUM (FUME OR DUST)	N
ALUMINUM OXIDE (FIBROUS FORMS)	N
AMETRYN	N
AMMONIA	N
ANILINE	N
ANTIMONY	N
ARSENIC	N
ATRAZINE	N
BARIUM	N
BENDIOCARB	N
BENOMYL	D, N
BENZAL CHLORIDE	N
BENZENE	D, N
BENZIDINE	N
BENZOIC TRICHLORIDE	N
BENZYL CHLORIDE	N
BIFENTHRIN	N
BIPHENYL	N
BIS(2-CHLORO-1-METHYLETHYL) ETHER	N
BIS(TRIBUTYLTIN) OXIDE	N
BORON TRIFLUORIDE	N

Chemical Name	Developmental Toxin (D) or Neurotoxin (N)	Chemical Name	Developmental Toxin (D) or Neurotoxin (N)
BROMINE	N	DICHLOROBROMOMETHANE	N
BROMOCHLORODIFLUOROMETHANE	N	DICHLORODIFLUOROMETHANE	N
BROMOFORM	N	DICHLOROMETHANE	N
BROMOMETHANE	D, N	DICHLOROTETRAFLUOROETHANE (CFC-114)	N
BROMOTRIFLUOROMETHANE	N	DICHLORVOS	N
BROMOXYNIL	D	DICOFOL	N
BROMOXYNIL OCTANOATE	D	DICYCLOPENTADIENE	N
CADMIUM	N	DIETHANOLAMINE	N
CAPTAN	N	DIGLYCIDYL RESORCINOL ETHER	N
CARBARYL	N	DIMETHOATE	N
CARBOFURAN	N	DIMETHYL PHTHALATE	N
CARBON DISULFIDE	D, N	DIMETHYL SULFATE	N
CARBON TETRACHLORIDE	N	DIMETHYLAMINE	N
CARBONYL SULFIDE	N	DINITROBUTYL PHENOL	D, N
CARBOXIN	N	DINITROTOLUENE (MIXED ISOMERS)	N
CATECHOL	N	DINOCAP	D
CHLORDANE	N	DIPHENYLAMINE	N
CHLORINE	N	DISODIUM CYANODITHIOIMIDOCARBONATE	D
CHLOROBENZENE	N	EPICHLOROHYDRIN	D, N
CHLORODIFLUOROMETHANE	N	ETHOPROP	N
CHLOROETHANE	N	ETHYL ACRYLATE	N
CHLOROFORM	N	ETHYL DIPROPYLTHIOCARBAMATE	D, N
CHLOROMETHANE	N	ETHYLBENZENE	N
CHLOROPICRIN	N	ETHYLENE	N
CHLOROPRENE	N	ETHYLENE GLYCOL	N
CHLOROTHALONIL	N	ETHYLENE OXIDE	D, N
CHLORPYRIFOS METHYL	N	ETHYLENE THIOUREA	D
CHLORSULFURON	D	ETHYLENEIMINE	N
COBALT	N	ETHYLIDENE DICHLORIDE	N
CREOSOTE	N	FAMPHUR	N
CRESOL (MIXED ISOMERS)	N	FENTHION	N
CUMENE	N	FLUOROURACIL	D, N
CYANAZINE	D, N	FORMALDEHYDE	N
CYANIDE COMPOUNDS	N	FORMIC ACID	N
CYCLOATE	D, N	FREON 113	N
CYCLOHEXANE	N	HEPTACHLOR	D, N
CYCLOHEXANOL	D, N	HEXACHLORO-1,3-BUTADIENE	N
CYFLUTHRIN	N	HEXACHLOROBENZENE	D, N
DAZOMET	N	HEXACHLOROCYCLOPENTADIENE	N
DI(2-ETHYLHEXYL) PHTHALATE	N	HEXACHLOROETHANE	N
DIAZINON	N		
DIBUTYL PHTHALATE	N		

Chemical Name	Developmental Toxin (D) or Neurotoxin (N)	Chemical Name	Developmental Toxin (D) or Neurotoxin (N)
HYDRAMETHYLNON	D	MOLYBDENUM TRIOXIDE	N
HYDRAZINE	N	MONOCHLOROPENTAFLUOROETHANE	N
HYDRAZINE SULFATE	N	MYCLOBUTANIL	D
HYDROGEN CYANIDE	N	N,N-DIMETHYLANILINE	N
HYDROGEN FLUORIDE	N	N,N-DIMETHYLFORMAMIDE	N
HYDROQUINONE	N	N-HEXANE	N
IMAZALIL	N	N-METHYL-2-PYRROLIDONE	N
IRON PENTACARBONYL	N	N-METHYLOLACRYLAMIDE	N
ISOFENPHOS	N	N-NITROSODIMETHYLAMINE	N
ISOPROPYL ALCOHOL	N	NABAM	D
LEAD	N	NAPHTHALENE	N
LEAD COMPOUNDS	N	NICKEL	N
LINDANE	N	NICOTINE AND SALTS	N
LINURON	D	NITRAPYRIN	D
LITHIUM CARBONATE	D, N	NITROBENZENE	N
M-CRESOL	N	NITROGLYCERIN	N
M-DINITROBENZENE	D, N	O-ANISIDINE	N
M-XYLENE	N	O-CRESOL	N
MALATHION	N	O-DINITROBENZENE	D, N
MALONONITRILE	N	O-TOLUIDINE	N
MANEB	N	O-XYLENE	N
MANGANESE	N	OXYDIAZON	D
MANGANESE COMPOUNDS	N	OZONE	N
MERCURY	N	P-CRESOL	N
MERCURY COMPOUNDS	N	P-DINITROBENZENE	D, N
MERPHOS	N	P-NITROANILINE	N
METHACRYLONITRILE	N	P-PHENYLENEDIAMINE	N
METHAM SODIUM	D	P-XYLENE	N
METHANOL	N	PARALDEHYDE	N
METHOXONE	N	PARAQUAT DICHLORIDE	N
METHOXYCHLOR	N	PARATHION	N
METHYL ACRYLATE	N	PEBULATE	N
METHYL ETHYL KETONE	N	PENTACHLOROETHANE	N
METHYL HYDRAZINE	N	PENTACHLOROPHENOL	N
METHYL IODIDE	N	PHENOL	N
METHYL ISOBUTYL KETONE	N	PHENYTOIN	D, N
METHYL ISOTHIOCYANATE	N	PHOSPHINE	N
METHYL METHACRYLATE	N	PHOSPHORIC ACID	N
METHYL PARATHION	N	PHOSPHORUS (YELLOW OR WHITE)	N
METHYL TERT-BUTYL ETHER	N	PHTHALIC ANHYDRIDE	N
METHYLENE BROMIDE	N	PICRIC ACID	N
MOLINATE	N	PIPERONYL BUTOXIDE	N

Chemical Name	Developmental Toxin (D) or Neurotoxin (N)	Chemical Name	Developmental Toxin (D) or Neurotoxin (N)
POLYBROMINATED BIPHENYLS	N	TEMEPHOS	N
POLYCHLORINATED BIPHENYLS	N	TERT-BUTYL ALCOHOL	N
POTASSIUM DIMETHYLDITHIOCARBAMATE	D	TETRACHLOROETHYLENE	N
PROFENOFOS	N	TETRACYCLINE HYDROCHLORIDE	D
PROMETRYN	N	THALLIUM	N
PROPACHLOR	N	THIABENDAZOLE	N
PROPANIL	N	THIODICARB	N
PROPARGITE	D	THIOPHANATE-METHYL	D, N
PROPARGYL ALCOHOL	N	THIRAM	N
PROPETAMPHOS	N	TOLUENE	D, N
PROPIONALDEHYDE	N	TOLUENE DIISOCYANATE (MIXED ISOMERS)	N
PROPOXUR	N	TOLUENE-2,4-DIISOCYANATE	N
PROPYLENE OXIDE	N	TOXAPHENE	N
PYRIDINE	N	TRIADIMEFON	D, N
QUINOLINE	N	TRIALLATE	N
QUINONE	N	TRIBUTYLTIN METHACRYLATE	N
S,S,S-TRIBUTYLTRITHIOPHOSPHATE	N	TRICHLOROETHYLENE	N
SAFROLE	N	TRICHLOROFLUOROMETHANE	N
SELENIUM	N	TRIETHYLAMINE	N
SELENIUM COMPOUNDS	N	URETHANE	D
SIMAZINE	N	VINCLOZOLIN	D
SODIUM AZIDE	N	VINYL ACETATE	N
SODIUM DIMETHYLDITHIOCARBAMATE	D	VINYL BROMIDE	N
SODIUM NITRITE	N	VINYL CHLORIDE	N
STYRENE	N	VINYLIDENE CHLORIDE	N
STYRENE OXIDE	N	XYLENE (MIXED ISOMERS)	N
SULFURYL FLUORIDE	N	ZINC (FUME OR DUST)	N
TEBUTHIURON	N	ZINEB	N

Appendix C

References Used to Identify Known or Suspected Neurotoxins

Source: Environmental Defense, Scorecard

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DAN: Nordic Council of Ministers and Danish National Institute of Occupational Health. Neurotoxic Substances in the Working Environment (Danish ad hoc list).

EDF: See EDF's Custom Hazard Identification documentation.

EPA-HEN: US Environmental Protection Agency. Health Effects Notebook for Hazardous Air Pollutants. Review Draft. December 1994. http://www.epa.gov/ttn/uatw/hapindex.html

EPA-SARA: US Environmental Protection Agency. SARA 313 Roadmaps Database. http://www.rtknet.org/

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NJ-FS: New Jersey Department of Health Services. Right to Know Program, NJDOH, Trenton, NJ. http://www.state.nj.us/health/eoh/rtkweb/

OEHHA-97: Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. Draft Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels. October 1997. http://www.oehha.org/air/chronic_rels/GETRELS.html

OEHHA-99: Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. Air Toxics Hot Spots Program Risk Assessment Guidelines, Part III, Draft Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels. June 1999 (http://www.oehha.ca.gov/air/chronic_rels/RAGSII.html) and October, 1999 (http://www.oehha.ca.gov/air/chronic_rels/RAGSp3draft.html).

RTECS: National Institute for Occupational Safety and Health's Registry of Toxic Effects of Chemical Substances. See EDF's Suspect Hazard Identification documentation.

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Endnotes

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15 Healthy from the Start, The Pew Environmental Health Commission, November 1999, p. 44. Provides a list of references to studies linking hazardous waste sites with low birthweight and preterm births.

16 A similar analysis could not be conducted for neurotoxin releases because of the prevasiveness of neurotoxin emissions. There are more than 200 reportable known or suspected neurotoxins compared with 45 developmental toxins, and facilities releasing specific neurotoxins can generally number in the thousands. For example, methanol and ammonia, the top neurotoxin releases in TRI, were reported by 2,311 and 2,575 facilities respectively. Emissions of carbon disulfide, the second highest released developmental toxin, were reported by only 92 facilities in 1998. Industrial sources of other developmental toxins are also counted in the dozens or at most hundreds, rather than thousands. With fewer developmentally toxic chemicals reportable to TRI and their emissions generally restricted to particular industries, a more robust and meaningful demographic analysis could be conducted.

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20 Although we can conclude that elevated levels of some developmental and neurological toxins have some impact on development and on mental functioning across the population, we can never say with any certainty the degree to which the deficits in any particular child are due to environmental exposures. This is because several variables can contribute to any one birth defect, developmental abnormality, or behavior or learning problem. These variables include diet, genetics, disease, and environmental factors.

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