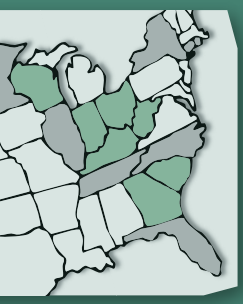
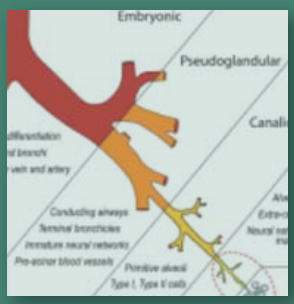
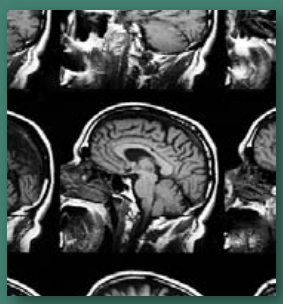
A Story of Health







ACKNOWLEDGEMENTS

Primary Development Organizations

The Agency for Toxic Substances and Disease Registry (ATSDR), the Collaborative on Health and the Environment (CHE), the Office of Environmental Health Hazard Assessment, California Environmental Protection Agency (OEHHA), the Science and Environmental Health Network (SEHN), and the University of California, San Francisco, Pediatric Environmental Health Specialty Unit (UCSF PEHSU) teamed up to leverage our combined resources to develop and produce *A Story of Health*.

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Suggested citation: Miller M, Schettler T, Tencza B, Valenti M. *A Story of Health*. Agency for Toxic Substances and Disease Registry, Collaborative on Health and the Environment, Science and Environmental Health Network, University of California, San Francisco, Pediatric Environmental Health Specialty Unit. PDF file online.

Dedication:

This eBook is dedicated to our designer Stephen Burdick for his extraordinary talent and vision.
- The authors.

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REVIEWERS

We gratefully acknowledge the following people who reviewed draft sections of a Story of Health, noting that their review does not constitute an endorsement of the findings or conclusions. Any errors or misrepresentations that remain are entirely the responsibility of the authors.

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Developmental Disabilities (Amelia's Story): David Bellinger; Lucy Crain; Katherine Herz; Brian Linde; Elise Miller; Leslie Rubin; Madeleine Scammell; Maureen Swanson

Childhood Cancer (Stephen's Story): Myles Abbott; Gary Dahl; Maida Galvez; Catherine Metayer; Elizabeth Raetz; Joshua Schiffman; Oscar Tarrago; Christopher Vlasses; Joseph Wiemels

FUNDERS

In addition to significant in-kind contributions from all of the primary development organizations, we are grateful to the following funders who have made this project possible:

Agency for Toxic Substances and Disease Registry (ATSDR)

The John Merck Fund

The Jacob & Valeria Langeloth Foundation

The Office of Environmental Health Hazard Assessment, California Environmental Protection Agency (OEHHA)

The UCSF PEHSU

The US Environmental Protection Agency

Disclaimers:

1. The UCSF Regional Pediatric Environmental Health Specialty Unit (PEHSU) prepared A Story of Health on behalf of the American College of Medical Toxicology (ACMT) and funded as part of the cooperative agreement award number 1U61TS000238-01from the Agency for Toxic Substances and Disease Registry (ATSDR).

2. The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the organizations listed (above) as funders.

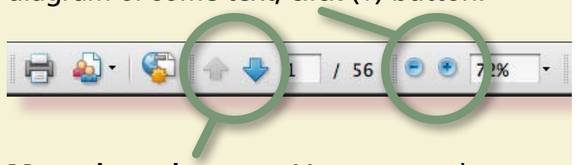
3. The ATSDR, US EPA, and Cal EPA/OEHHA do not endorse the purchase of any commercial products or services mentioned in this publication.

HELP PAGE How to Navigate Our eBook

Adobe Acrobat Tools

This interactive pdf document is best viewed on a laptop or desktop, down-loaded and opened in a current version of Adobe Acrobat Reader. Refer to the top Adobe menu bar for features including:

Magnify - If you want to enlarge a diagram or some text, click (+) button.



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You can also move through pages using the scroll up and down feature to the right of your screen.

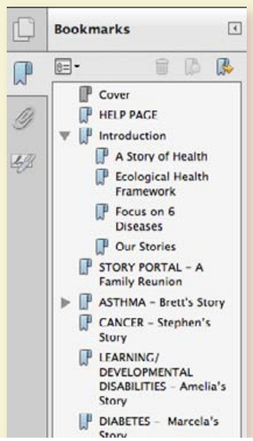


Table of Contents

Use the sidebar Bookmark Tools as a table of contents to skip to a section of interest, find your place, or return to this Help page.

THE INDIVIDUAL STORIES OF HEALTH in this eBook are written to address many audiences. For example, some sections are more technical than others – you can skip sections if you wish.

(Note: underlined words or phrases link to online information, prompt down-loads or navigate to a related page.)

EACH OF THE EBOOK STORIES is embedded with a wide range of resources. These help further explain possible environmental and/or genetic "risk factors" – (contributors to the development of a disease, or factors that might make a disease worse) – and how these factors interact. We also provide links for additional resources, including actions you can take to prevent disease, and "tools you can use."

Our eBook Navigation: Click on selections in the bar at the top of each page to move between stories, navigate back to this 'Help Page', and to find out more in the References section.

If you lose your place, use the 'Go Back' selection in the navigation bar to return to your previous screen.

Icons

Click on icons that appear throughout the stories for pop-ups, videos, and links to more information as described.

Skip this section - If you wish to skip a technical section, choose the "Skip this section" arrow and you will jump to the page after the technical sections ends.

key concept | **watch a video** | **additional resources, tools** | **technical details for health professionals** | **skip this section** | **definition**

RESOURCES INCLUDE videos, slides with audio commentary, tables, charts, and graphics. Some 'pop-up' in the story, and some connect online. Through these links, you can choose to dig deeper and learn more. Refer to the icons (above) for guidance.

REFERENCES AND CITATIONS: Certain references are cited in the text where we believe they are most warranted. Full references by topic can be found at the end of each story.

You can skip this section and continue to the Story of Health introduction.

INTRODUCTION

This is a story about health.

It is a story of how our own health is intimately connected with the health of our families, friends and communities.

It is a story about how human health is interdependent with our surroundings.

Our overall story is told through the personal stories of a number of fictional people of various ages attending a family reunion.

These individual stories highlight the many ways our health is influenced by the complex environments where we live, eat, work, play, volunteer, gather and socialize.

INTRODUCTION

Our stories explore how many aspects of our lives, and what we are exposed to in our environments, influence health across the lifespan—from the beginning of fetal development to elder years—and how they can promote health and resilience, or disease and disability.

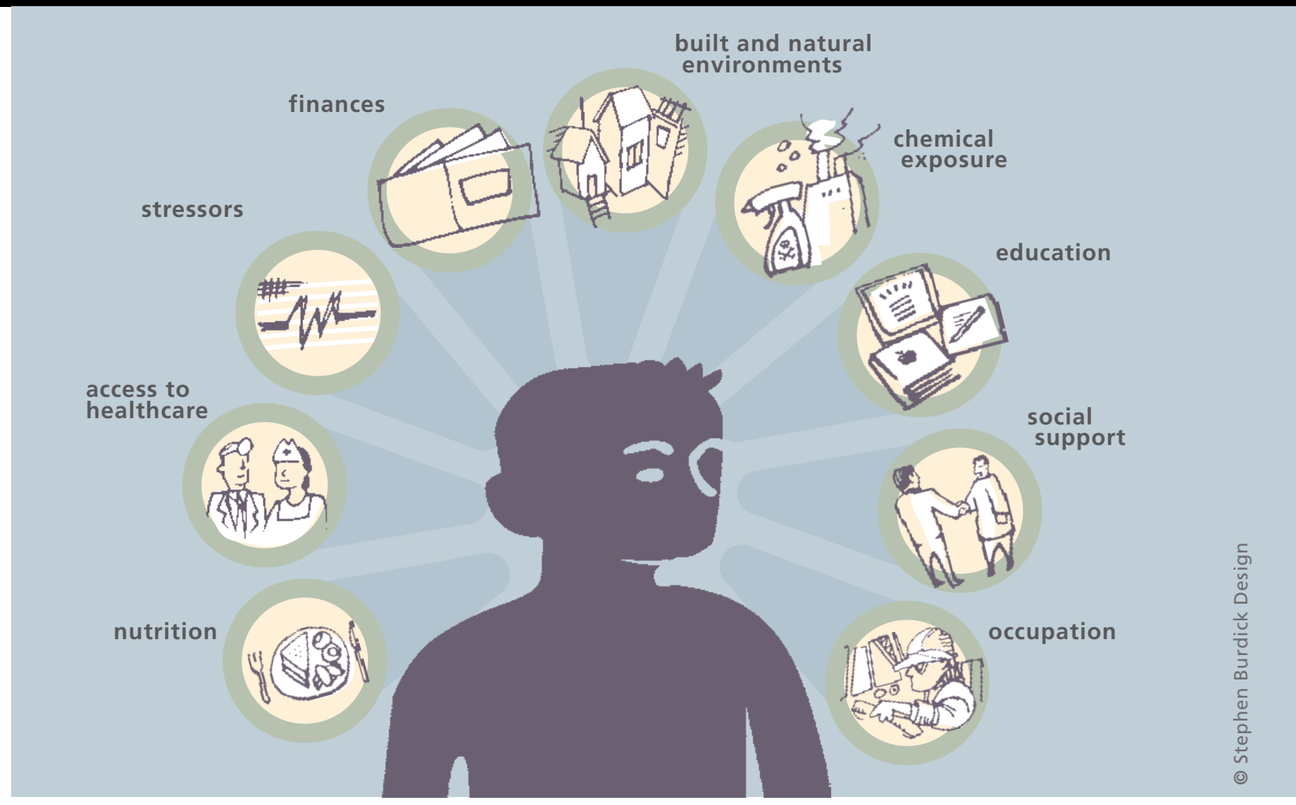
Important determinants of health come from the natural, built, chemical, food, economic, and social environments.

These environments are further expressed through such things as education, housing, nutrition, access to health care, social supports and more.

Many of them interact to create the conditions for health and wellness, or vulnerability to disease.

Watch: Pediatrician Larry Rosen addresses the environment and family health. (2 min.)

Lawrence D. Rosen MD is an integrative pediatrician and founder of the Whole Child Center.



Complex interactions occur among many variables and across individual, community, and societal levels. These aspects of our lives are not independent of one and other.

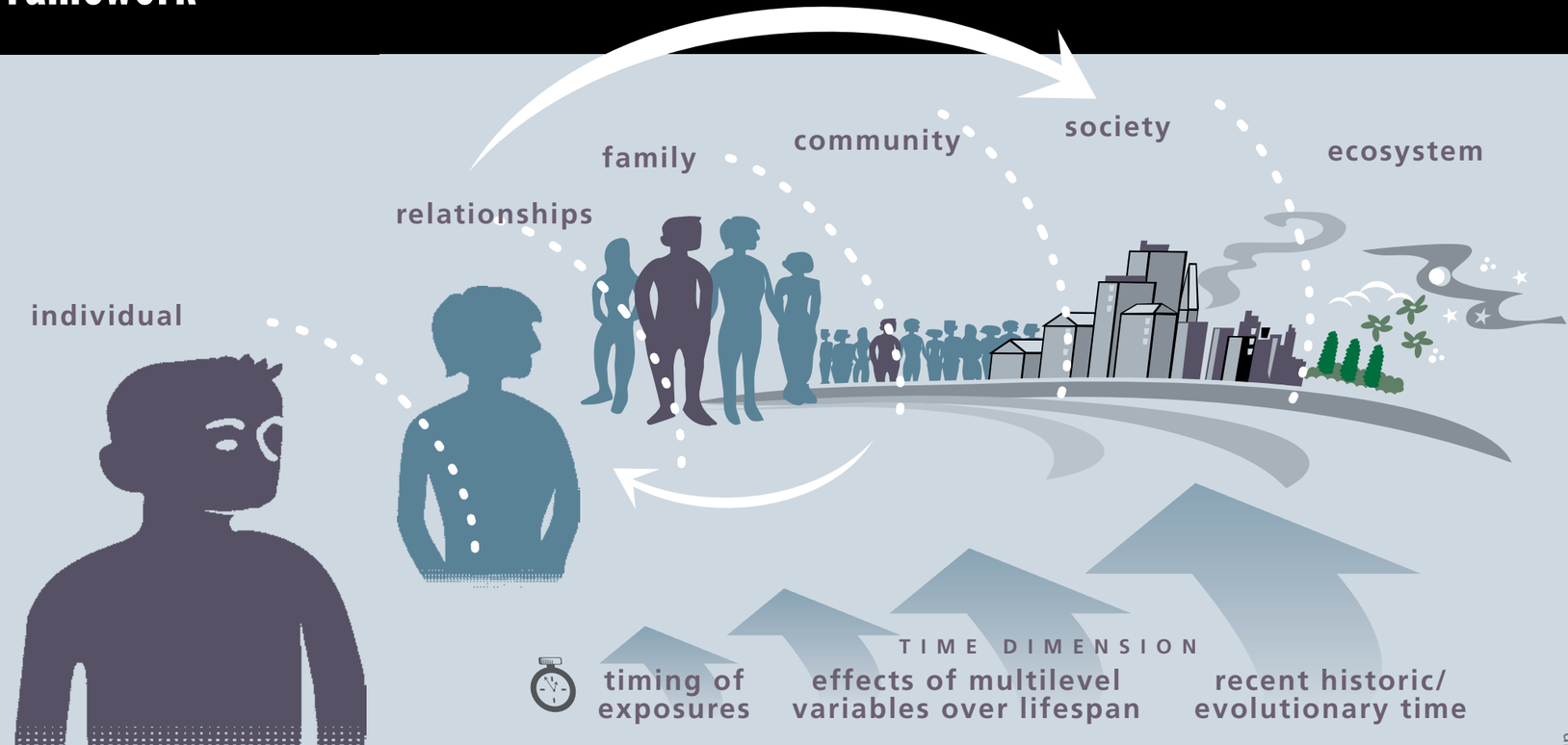
Rarely is one particular thing responsible for health or disease, so we refer to this as a multifactorial (or ecological) approach, the best way to promote health and prevent disease.

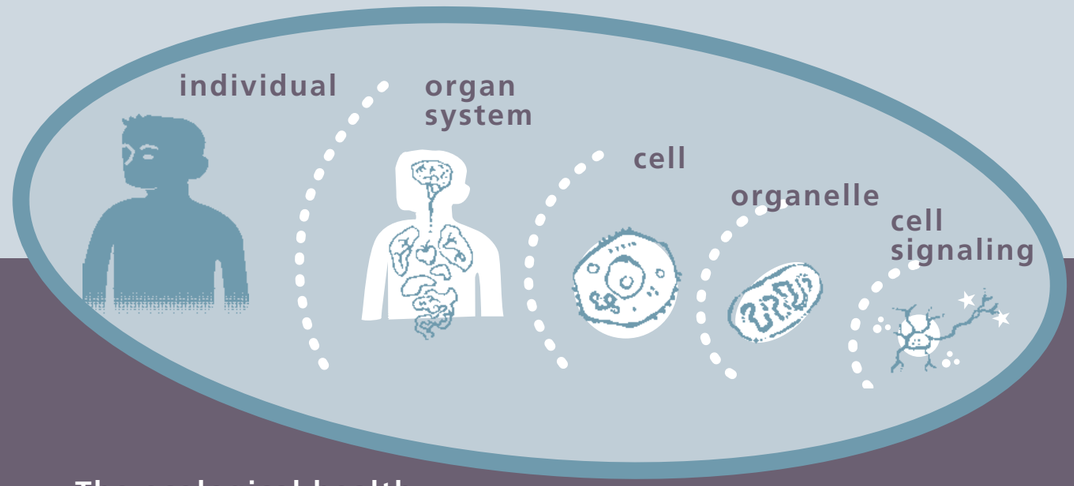
INTRODUCTION Ecological Health Framework

The ecological framework can include multiple levels from sub-cellular to societal.

It is not hierarchical in the sense that one level is more important than another, but rather in the sense that individual biology is progressively nested within the person, family, community, society and ecosystem.

The interactions and feedback loops within, across, and among these levels are complex and variable. They exert their influences on health across time.





The ecological health framework also extends to the sub-cellular level.

INTRODUCTION Focus on Six Diseases

Following are stories of people like you and me, our partners, families and friends, our mothers and fathers, sisters and brothers, children, grandparents, cousins, and aunts and uncles.

The personal health stories we will explore include some of the most common and troubling diseases and disorders of our time.

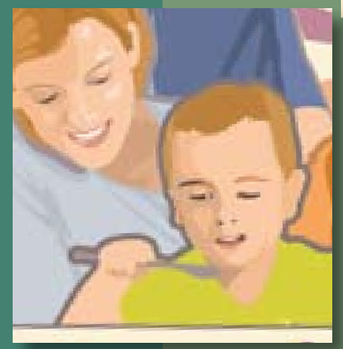
They include:

- Asthma
- Cancer (childhood leukemia)
- Diabetes
- Infertility
- Learning and developmental disabilities
- Cognitive decline

Asthma

Diabetes

Cancer



Cognitive decline

Infertility

Learning and developmental disabilities

INTRODUCTION Our Stories

These stories are not meant to be an exhaustive accounting of every variation of a disease or every possible cause.

Rather, we present current, authoritative scientific evidence to enable you to better understand environmental contributors and make more informed decisions and take action to help improve your health, and the health of your family, friends, community, and patients.

A FAMILY REUNION Six Stories

This page is your portal to six stories of health.

It is recommended that you read through the introduction first and then choose stories in the order you wish.

Health professionals can receive CE credits for completing *A Story of Health*. Click here for more details.

Choose stories in the order you wish. Select a disease term to highlight the affected person. Click the arrow button to read his or her fictional story of health.

Asthma | Cancer | Learning/ Developmental Disabilities | Diabetes | Infertility | Cognitive Decline

INTRODUCTION Free Continuing Education

Information on free continuing education offered from the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry

Each of the fictional stories in *A Story of Health* offers free continuing education (CE). On the "Final Thoughts" page of the last story of the entire eBook, or of each story (if you download them separately), you will be prompted to register for CE through a hyperlink.

This hyperlink links to the CDC/ ATSDR CE page where you can register and take the test for CE credits for each story (credits are offered by story). Before you begin each story, please review the learning objectives at right. These will help you focus as you read each story, and prepare you for each CE test.

Review these learning objectives for each story:

- Brett's Story (Asthma) >
- Stephen's Story (Cancer/Childhood Leukemia) >
- Amelia's Story (Developmental Disabilities) >

FREE CONTINUING EDUCATION

Continuing education available by specialty

- Continuing Medical Education (CME) for Physicians
- Continuing Nursing Education (CNE) for Nurses
- Continuing Education Units (CEU) for other Professionals
- Continuing Education Contact Hours (CECH) for Certified Health Education Specialists (CHES)

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story *

Amelia is a 13-year-old who lives with her parents Darrell and Gloria in a small town in Louisiana.

She enjoys being with her friends, riding her bike, playing soccer, listening to music, and helping out at the restaurant where her mother is the bookkeeper.

Amelia likes school, although she has difficulty learning and is occasionally socially awkward.

Like one in six young people in America, Amelia has a developmental disability.

More information on learning and developmental disabilities definitions and US trends

(*a fictional case)

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More information on learning and developmental disabilities definitions and US trends

Specific Developmental Disabilities in U.S. Childrens Aged -17 Years*

Disability	Percent Change between 1997-1999 and 2006-2008
Any developmental disability	17.1%^
ADHD	33.0%^
Autism	289.5%^
Blind/unable to see at all	18.2%
Cerebral palsy	-
Moderate to profound hearing loss	-30.9%
Learning disability	5.5%
Intellectual disability	-1.5%
Seizures, past 12 months	9.1%
Stuttered or stammered, past 12 months	3.1%
Other developmental delay	24.7%^

Link: Developmental Disabilities Increasing in US

Developmental Disabilities Definitions and US Trends

Developmental disabilities (DD) are a diverse group of conditions that are neurologically based and result in physical and/or mental impairments that affect function and performance in many ways.

People with DD may have difficulty with physical activities such as walking or manipulating objects, difficulties with speech, language, communication, interaction, and socialization, as well as difficulties with learning and cognitive skills that may affect their ability to live and work independently.

Developmental disabilities begin anytime during development up to 22 years of age and usually last throughout a person's lifetime. It is very important that any disabilities are identified as early as possible in order to provide the necessary therapies, interventions, and education that will help the child reach his or her full potential.

As can be seen from the table above, there has been an alarming increase in the rate of most DD conditions that indicate a serious public health challenge requiring urgent attention. Not all children are affected equally, for example, boys are more likely than girls to have autism and ADHD (Ekanayake et al., 2014), and poor children who are insured with Medicaid are also more likely to have ADHD, learning disabilities and intellectual disabilities than their more affluent peers who have private insurance. (Rubin et al., 2012)

***Centers for Disease Control and Prevention, National Center for Health Statistics, NHS, 1997-2008.**

^Statistically significant trend over four time periods (1997-1999, 2000-2002, 2003-2005, 2006-2008).

Graphic used with permission.

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

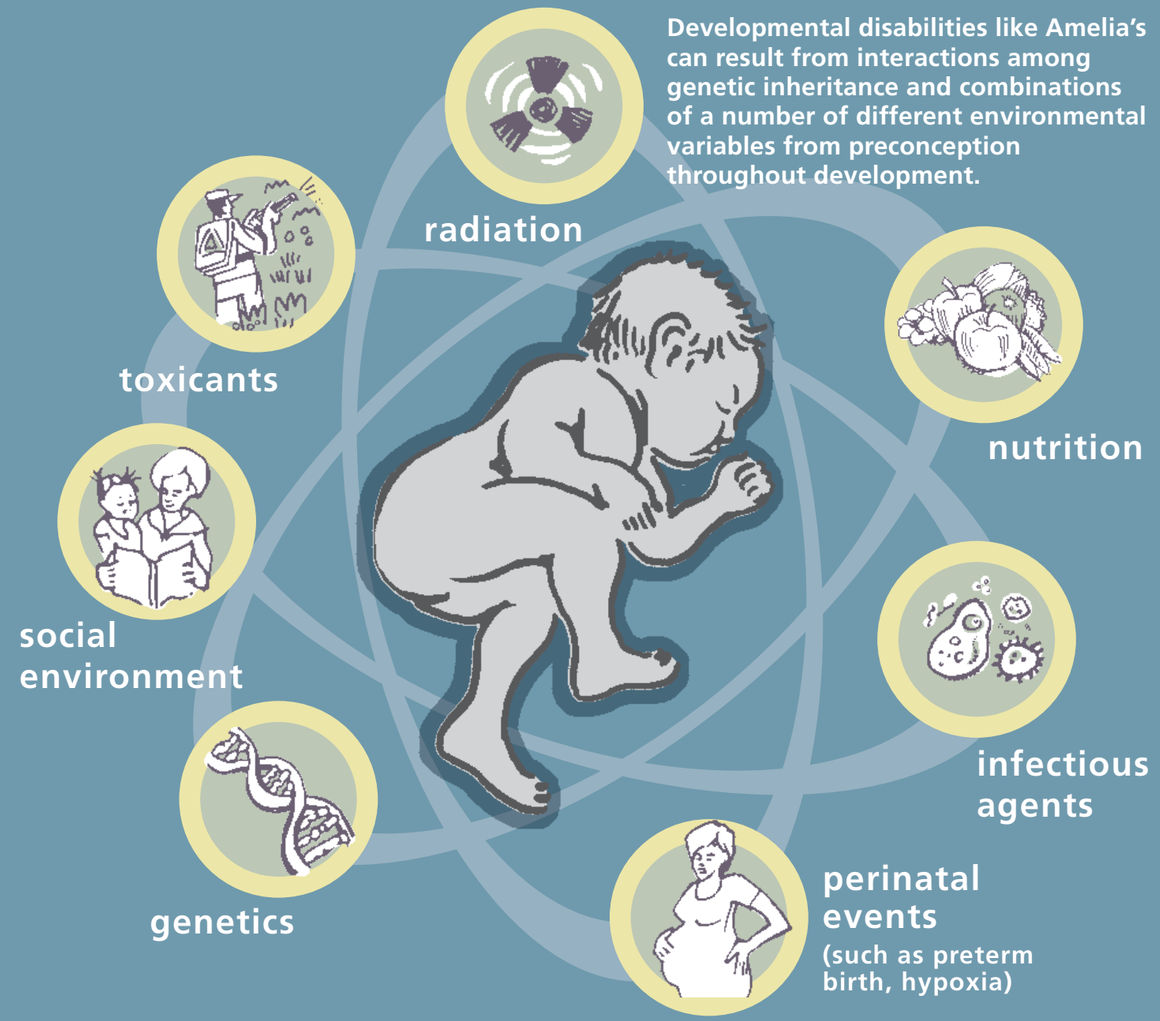
A single variable, such as birth trauma or prenatal exposure to alcohol, may sometimes be the cause of a developmental disability.

More commonly, however, multiple risk factors combine to alter brain development and/or function in a variety of ways, resulting in a developmental disability.

Developmental disorders are generally better conceptualized as heterogeneous (different) conditions arising from interactions among genetic and environmental factors. (See "More" below for in-depth information.)

More on environmental and genetic contributors to developmental disabilities

Multiple Contributors to Developmental Disabilities



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More on environmental and genetic contributors to developmental disabilities

Environmental and Genetic Contributors to Developmental Disabilities

While environmental chemicals like lead or organophosphate pesticides are toxic to everyone, certain inherited genes can influence the response of particular individuals and increase their susceptibility to cognitive and behavioral problems after exposures.

Environmental factors reported to be associated with ADHD*

For example, some genes affect the metabolism of organophosphate pesticides (such as the paraoxonase gene) while others may have modest effects on lead absorption and metabolism (such as the vitamin D receptor and delta-aminolevulinic acid dehydratase genes).

Twin Studies

Family and twin studies help in estimating the extent to which the origins of various developmental disabilities can be attributed to genetic inheritance or the shared and unshared environments. Twins share the same uterine environment and usually, but not always, share the same home environment after birth.

Shared environmental influences are those that are more common among individuals within a family than in unrelated individuals in the general population. They may include environmental influences within the home or other shared experiences such as having mutual friends or teachers. Non-shared environmental influences for twins who live in the same home could be a head injury, another kind of unique traumatic event, exposure to a physical or toxic chemical substance, or some kind of abuse to which the other twin was not similarly exposed.

Twin studies of children with ADHD generally find a relatively high genetic correlation with symptoms of inattention, hyperactivity, and impulsivity in children with ADHD. (Thapar, 2012) But even in identical twins who are more likely to have similar symptoms than fraternal twins, the concordance is not 100%, suggesting that non-inherited factors also contribute.

In comparison, inherited genetic predisposition to reading and math problems in children with learning disabilities appears to be considerably less. (Willcutt et al., 2010)

Autism spectrum disorder has historically been thought to result primarily from genetic susceptibility, but recent twin studies show that shared environmental factors contribute at least 50% of autism risk. (Hallmayer, 2011; Sandin, 2014)

These observations are reminders of the importance of gene-environment interactions in individuals with and without particular genetic susceptibility.

*Thapar A, Cooper M, Jeffries R, Stergiakouli E. What causes attention deficit hyperactivity disorder? Arch Dis Child. 2012;97:260–265

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

DEVELOPMENTAL MILESTONES

Amelia's developmental disability was not particularly noticeable at a young age. Her developmental milestones had been only slightly delayed compared to her peers, and she also seemed to be somewhat inattentive, but otherwise progressed reasonably well.

In addition, the subtle expression of her delays and difficulties was missed by her parents, who were distracted after her baby brother David was born.

? **More information on Developmental Milestones >**

Checklists for Parents:

CDC's Developmental Milestones by specific age

Watch: How early recognition of developmental disabilities can assist parents and providers.

Learning and math disabilities and IQ

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

Amelia's parents, Darrell and Gloria, first became somewhat concerned that she might be having difficulty with school work when she was in the second grade. She seemed to be having trouble paying attention and finishing tasks like her homework.

They decided, though, that she was just going through some normal adjustments at school and at home. Because they were both working long hours at their jobs, taking care of a new baby, and struggling with finances, they did not seek help for Amelia at that time as her difficulties did not seem to be very serious.

Both parents did make sure they spent time with her to help her read and comfort her when she seemed frustrated.

The beneficial effects of an enriched social environment

For these and other reasons, her parents put off addressing Amelia's problem until a parent-teacher meeting in the third grade, where they learned more about the difficulty Amelia was having in school. They realized they needed to take action.

Watch: Dr. Mark Miller describes the benefits of an enriched social environment and the way it influences brain structure and function.

Mark Miller MD MPH, Director, Children's Environmental Health Program, Office of Environmental Health Hazard Assessment, California EPA; Director, UCSF Pediatric Environmental Health Specialty Unit

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

EVALUATION OF LEARNING DISABILITIES

Amelia's parents met with the school psychologist, Mr. Richards, who did an evaluation to determine Amelia's education needs. He also offered to refer them to a medical setting to see if the family wanted to pursue further diagnosis. When they asked, he referred them to a center in a large city where she could be further evaluated.

? Evaluation – What does it mean?

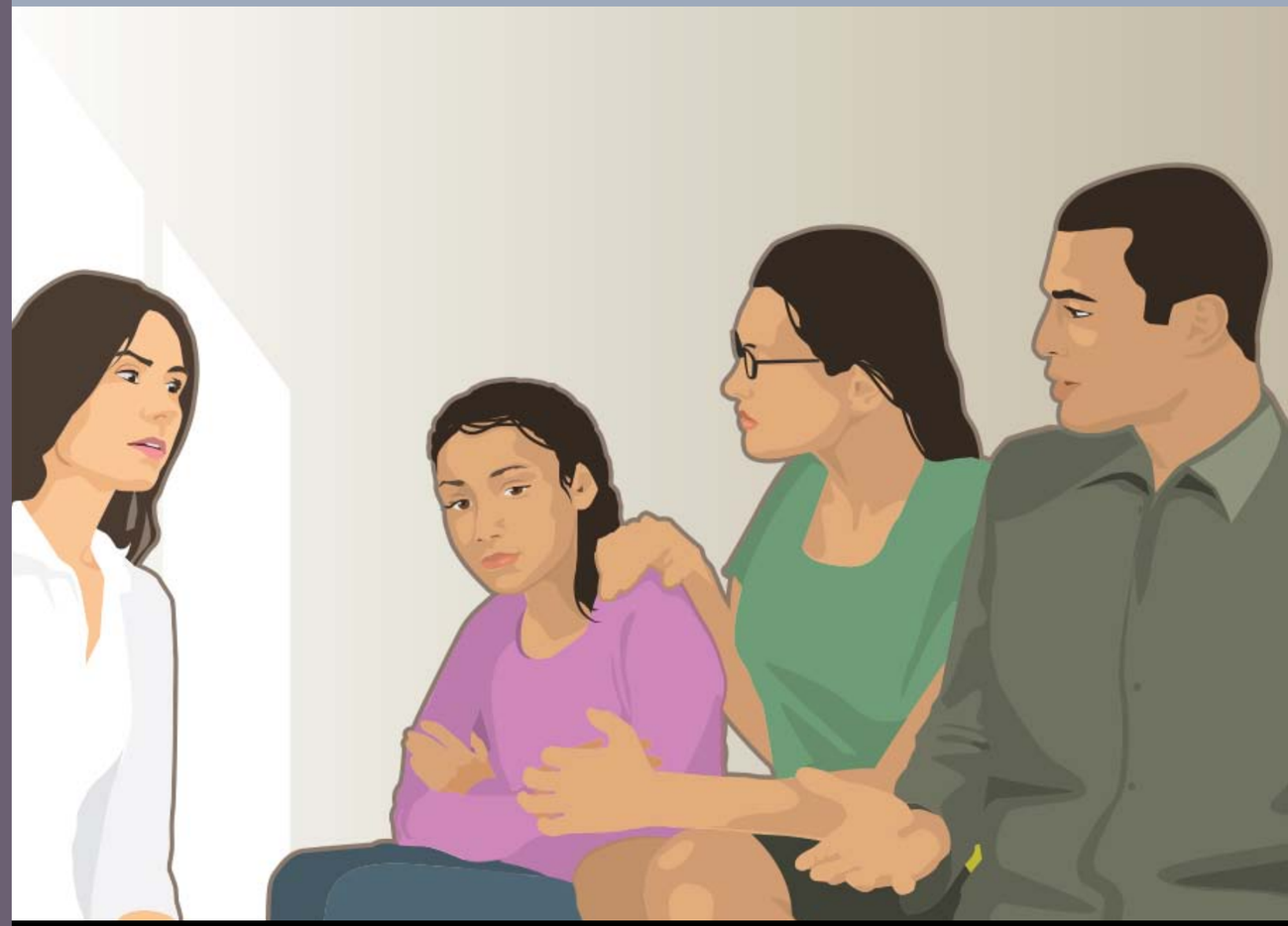
The medical setting was somewhat intimidating at first, but the people at the center made them feel at ease. They were introduced to Dr. Bradley, a developmental pediatrician, who said she would be conducting a number of screening procedures with Amelia.

After the screening, Dr. Bradley met with Amelia and her parents. She explained that Amelia's challenges were somewhat difficult to categorize as she had several that cut across syndromes they might have heard of, such as ADHD.

She explained that Amelia's reading and comprehension difficulties qualified as a learning disability. However, Amelia also exhibited inattention during the testing but not sufficiently for a diagnosis of ADHD.

+ Find out more about Evaluations

LDA Learning Disabilities Association of America



LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

Dr. Bradley said she thought Amelia would do well with some extra help at school along with making other healthy living choices.

Developmental Screening Tools for Clinicians:

Developmental Screening in Early Childhood Systems, American Academy of Pediatrics (AAP)

Developmental and Behavioral Screening Initiative, Administration for Children & Families (ACF)

OVERLAPPING SYNDROMES

Learning and behavioral disorders often overlap with other categories. For example:

Among children with ADHD:

- **10-30% also have learning disabilities;**
- **30-50% also have language disability;**
- **30-80% have other behavior disorders.**

ADHD is also frequently associated with autism spectrum disorder, obsessive compulsive disorder, tic disorders, and intellectual disabilities.

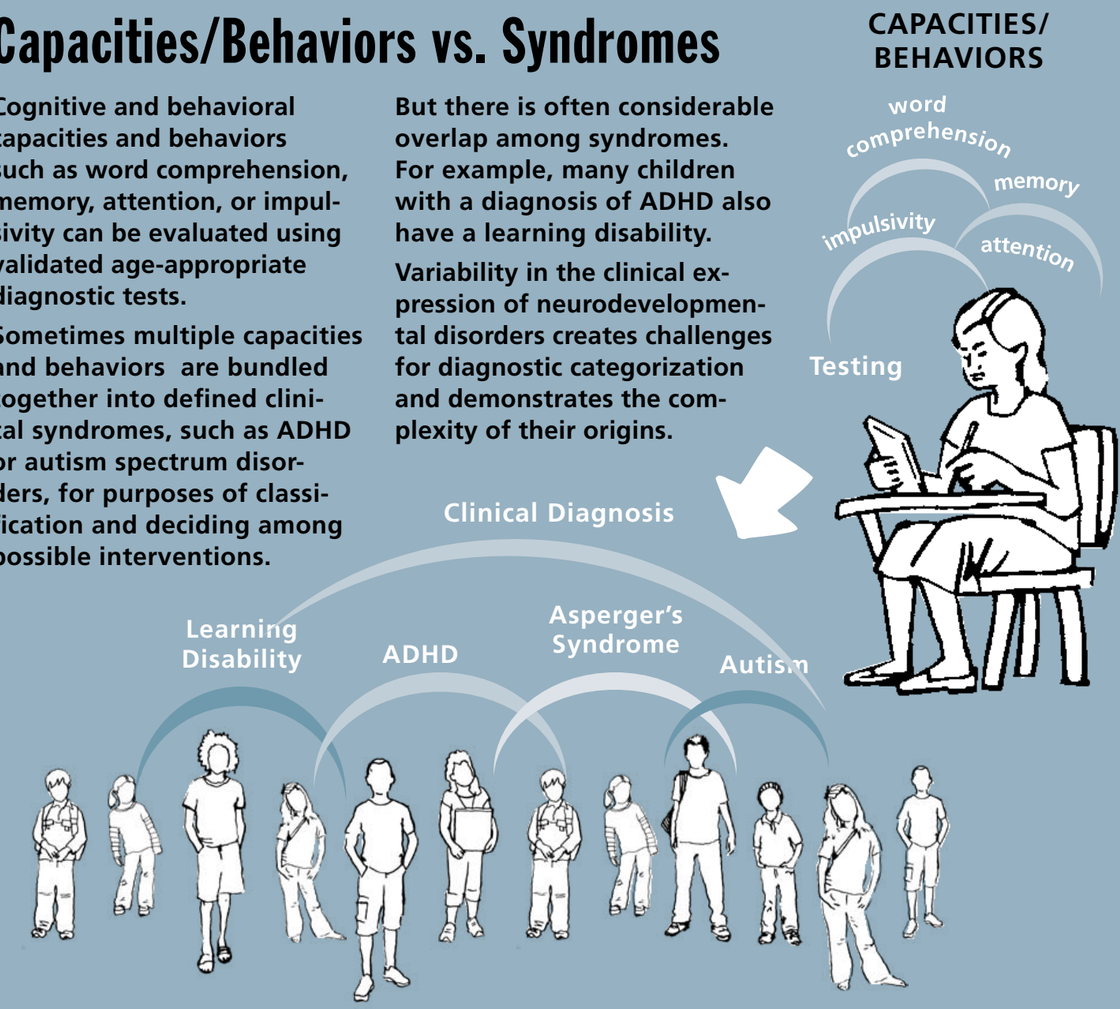
Capacities/Behaviors vs. Syndromes

Cognitive and behavioral capacities and behaviors such as word comprehension, memory, attention, or impulsivity can be evaluated using validated age-appropriate diagnostic tests.

Sometimes multiple capacities and behaviors are bundled together into defined clinical syndromes, such as ADHD or autism spectrum disorders, for purposes of classification and deciding among possible interventions.

But there is often considerable overlap among syndromes. For example, many children with a diagnosis of ADHD also have a learning disability.

Variability in the clinical expression of neurodevelopmental disorders creates challenges for diagnostic categorization and demonstrates the complexity of their origins.



Learning Disability

ADHD

Autism spectrum disorder

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

Amelia's parents, Darrell and Gloria, asked Dr. Bradley what could have caused Amelia's learning disability, and Dr. Bradley was interested in exploring that as well.

Dr. Bradley suggested that there is often a genetic predisposition and added that if Amelia had been born prematurely, or had a low birth weight, either could be a risk factor for her developmental disability.

Gloria told her that Amelia was a little underweight when she was born, but no one seemed very concerned about it at the time. Dr. Bradley also mentioned that smoking or drinking during pregnancy could increase the risk. Gloria told her that her husband had smoked during her pregnancy, although when Amelia was born he had quit with help from their local medical clinic.

Finally, Dr. Bradley told them about the risk to brain development from exposures early in life to other toxic chemicals and substances, such as lead, mercury, and diesel fumes from trucks and cars.

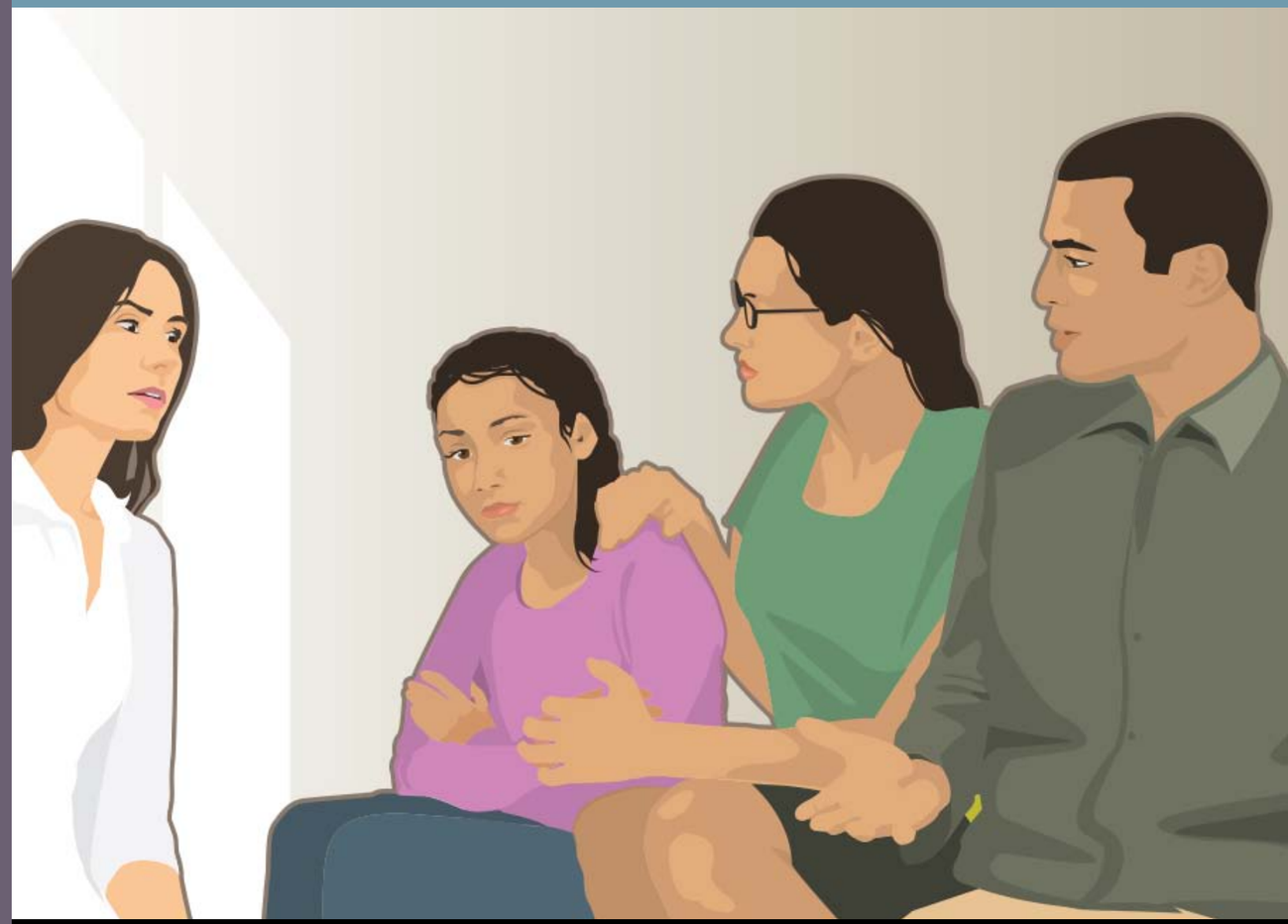
Preconception and Healthy Child Development

Prenatal Care and Healthy Child Development

Folate supplementation recommendations for women

A Rationale for Thyroid Screening

For Clinicians: Prenatal environmental health history form, PEHSU Region 5



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PRECONCEPTION AND HEALTHY CHILD DEVELOPMENT

Preconception care for women and men is important for lifetime health as well as healthy child development.

Images: Centers for Disease Control and Prevention

All women and men can benefit from healthy habits throughout life, whether or not they plan to have a baby one day. These include eating healthy food, getting regular exercise, avoiding toxic substances, and reducing excessive stress.

Some specific actions are also important for prospective parents to take even prior to conception because they can influence birth outcomes.

Maternal exposures to toxic chemicals before or around the time of conception can adversely affect the quality of eggs (ova) and newly-conceived embryos. But these exposures can be harmful to men's reproductive health as well. For example, a father's occupational exposure to pesticides has been associated with increased risk of some childhood cancers and birth defects in his offspring. (Roberts et al., 2012).

Parents can also take home from the workplace toxicants like lead and pesticides on their clothing, resulting in direct exposures to other family members. (Gerson et al., 1996; Fenske et al., 2013)

Nutritionally, a prospective father's diet that is deficient in folate (a "B" vitamin) increases the risk of birth defects in his offspring. (Lambrot et al., 2013). Similarly, maternal folate supplements in the periconceptual period (the time period around conception) help reduce the risk of birth defects

Recent studies also show periconceptual folate supplements associated with a significantly decreased risk of having a child with an autism specturm disorder. (Schmidt et al, 2012; Suren et al, 2013; Lyall, 2104)

Schmidt et al. also found greater risk reduction with daily folate > 0.6 mg when either the mother or child had specific higher risk polymorphisms in MTHFR genes. The MTHFR gene provides instructions for making methylenetetrahydrofolate reductase, a

More information: CDC's Preconception care for women and men

rate limiting enzyme in the methyl cycle. Some genetic variants of the enzyme result in altered or inactivated enzyme function. Altered enzyme activity can interfere with its ability to help process folate, a key nutrient for neurodevelopment. Some variants have been associated with increased risk for developing neural tube defects and other neurologic disorders. About 60% of the US population have at least one risk-conferring MTHFR gene.

Of course optimal nutrition and appropriate vitamin and mineral supplements throughout pregnancy are also important to help promote optimal fetal development.

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

Amelia's parents, Darrell and Gloria, asked Dr. Bradley what could have caused Amelia's learning disability, and Dr. Bradley was interested in exploring that as well.

Dr. Bradley suggested that there is often a genetic predisposition and added that if Amelia had been born prematurely, or had a low birth weight, either could be a risk factor for her developmental disability.

Gloria told her that Amelia was a little underweight when she was born, but no one seemed very concerned about it at the time. Dr. Bradley also mentioned that smoking or drinking during pregnancy could increase the risk. Gloria told her that her husband had smoked during her pregnancy, although when Amelia was born he had quit with help from their local medical clinic.

Finally, Dr. Bradley told them about the risk to brain development from exposures early in life to other toxic chemicals and substances, such as lead, mercury, and diesel fumes from trucks and cars.

Preconception and Healthy Child Development

Prenatal Care and Healthy Child Development

Folate supplementation recommendations for women

A Rationale for Thyroid Screening

For Clinicians: Prenatal environmental health history form, PEHSU Region 5

PRENATAL CARE FOR HEALTHY DEVELOPMENT

Images: Centers for Disease Control and Prevention

The fetus can be harmed by environmental exposures including:

- Mom's smoking and second hand smoke,
- Mom's drinking alcohol, and her exposure to other solvents like those in certain paints and in products used in nail salons,
- Mom's exposure to lead, mercury (from some fish and other sources), pesticides, PCBs (banned in the US but still found in the environment), and certain polybrominated diphenyl ethers (PBDEs – a family of chemicals long-used as flame retardants in foam and furniture), among others.

Actions to help protect the fetus:

- Avoid smoking or drinking,
- Maintain a healthy diet,
- Supplement with prenatal vitamins, including folic acid, iodine, and vitamin D if maternal serum levels are inadequate,
- Avoid toxicants.

More information:

- CDC on pregnancy
- American Congress of Obstetrics and Gynecology (ACOG):
  - Good Health Before Pregnancy (pdf)
  - Prenatal Nutrition
  - Environmental Chemicals
- Royal College of OB/GYN:
  - Chemical Exposures During Pregnancy
- UCSF: Program on Reproductive Health and the Environment

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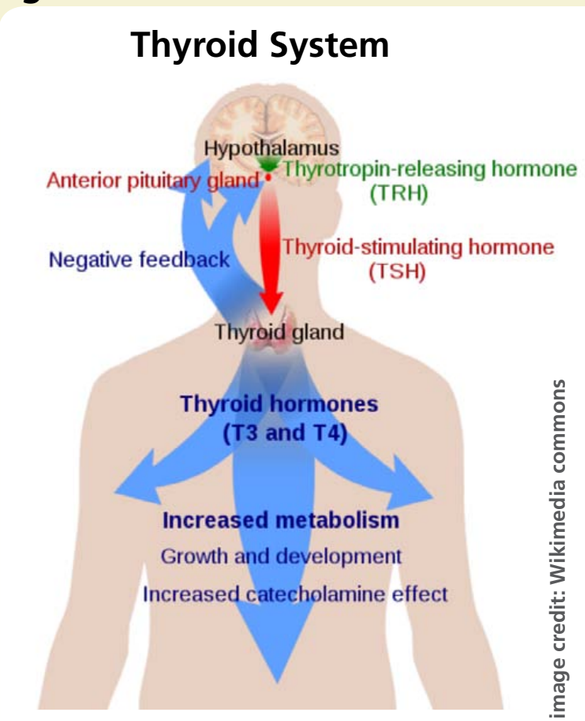
PRENATAL HEALTHY CARE

A Rationale for Thyroid Screening Before or During Pregnancy

Adequate levels of thyroid hormone are necessary for normal brain development. During the first trimester of pregnancy, before onset of fetal thyroid hormone production, an adequate supply of maternal thyroid hormone is essential. Recent studies show that even modest reduction in maternal TH, as in subclinical hypothyroidism (moderately elevated TSH and normal or low-normal T4 levels) or low-normal free T4 levels (below the 5th or 10th percentiles) with or without elevated TSH, is associated with suboptimal neurodevelopment (Haddow, 1999; Pop et al., 1999; LaFranchi, 2005)

According to the CDC, about 30% of women of reproductive age in the US have insufficient iodine intake. Iodine is an essential element in the production of thyroid hormones. The American Congress of Obstetricians and Gynecologists (ACOG) recommends that all prenatal vitamins contain at least 150 micrograms iodine, but many vitamins do not contain this amount.



Thyroid disruption technical diagram

A number of environmental chemicals can disrupt thyroid hormone levels and function through a variety of mechanisms. (Pearce & Braverman, 2009)

Opinions about the value of universal screening for maternal thyroid status during pregnancy differ between the Endocrine Society and American Thyroid Association. Nevertheless, experts generally agree that clinicians should attempt to identify women at risk for inadequate thyroid hormone and undertake corrective measures.

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

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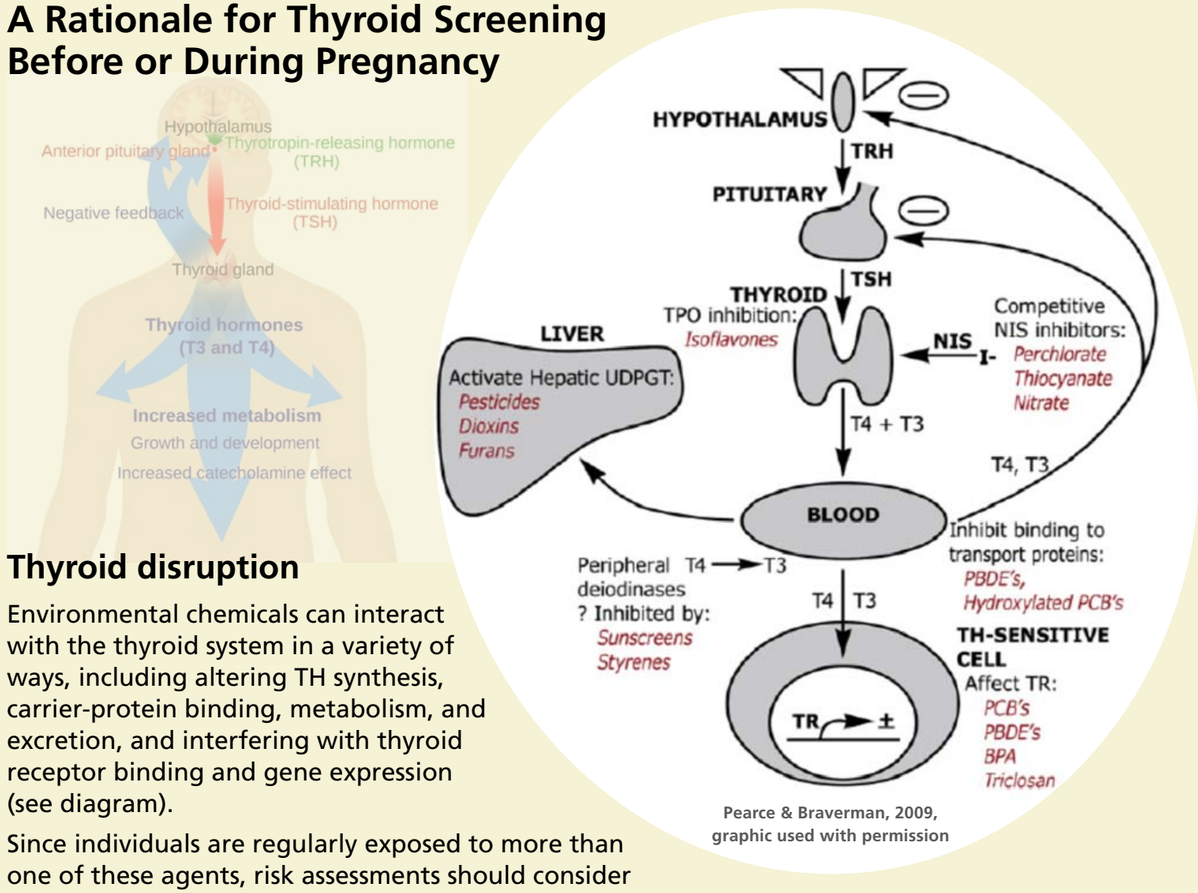


Pearce & Braverman, 2009, graphic used with permission

Thyroid disruption

Environmental chemicals can interact with the thyroid system in a variety of ways, including altering TH synthesis, carrier-protein binding, metabolism, and excretion, and interfering with thyroid receptor binding and gene expression (see diagram).

Since individuals are regularly exposed to more than one of these agents, risk assessments should consider cumulative exposures when assessing the safety of a single chemical. (Science and Decisions: Advancing Risk Assessment. Natl. Research Council.) Unfortunately this is not yet routine practice.

Clinicians should be aware of the many variables that can influence the thyroid hormone status of patients, and strongly consider assessing thyroid hormone status in women of reproductive age and women who are pregnant.

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

BRAIN DEVELOPMENT

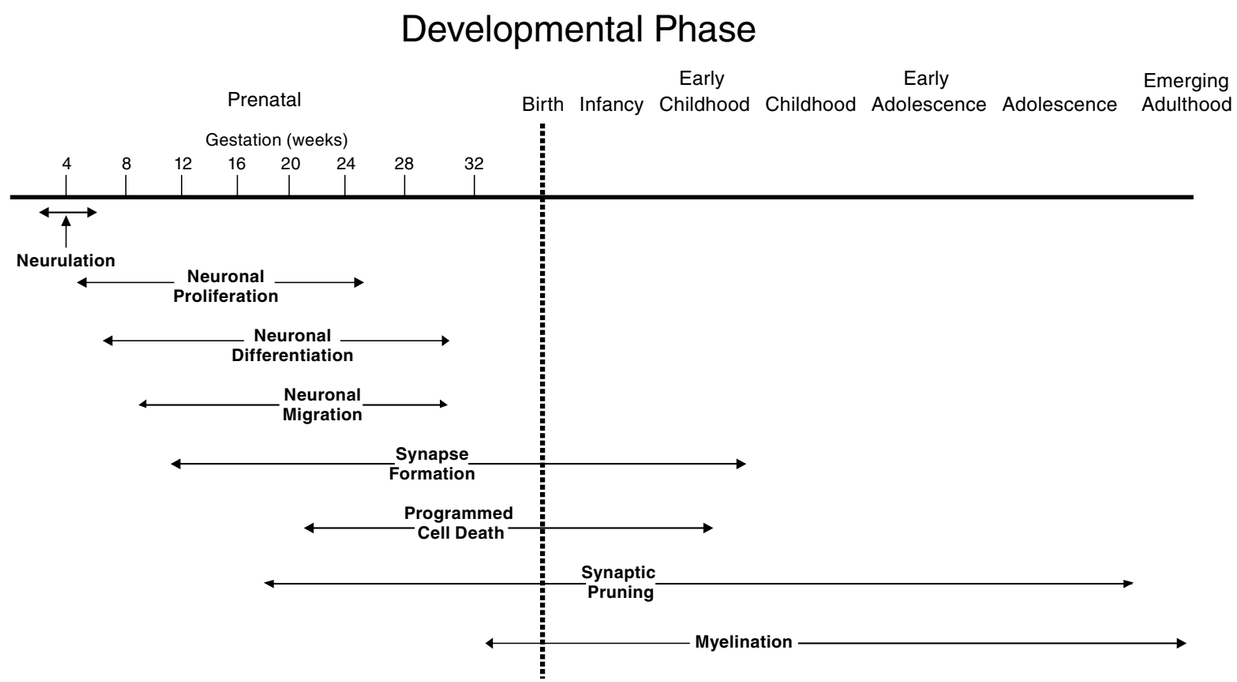
Brain development begins soon after conception and continues throughout adolescence into adulthood. It is characterized by a critical sequence of events that helps to determine brain structure and function. Each of these processes is subject to disruption by exposure to various environmental agents. Inadequate nutrition and adverse social circumstances can also impair these developmental processes.

Even brief disruptions during critical periods of early brain development can have significant downstream effects with long-lasting consequences.

The clinical manifestation of disruption from neurodevelopmental toxicants or other stressors depends on the nature of the agent as well as the size, timing, and duration of exposure.

Find out more: Cellular events in neurodevelopment

Timeline of major events in brain development



Source: Preventing Mental, Emotional and Behavioral Disorders Among Young People: Progress and Possibilities. **Mary Ellen O'Connell, Thomas Boat, and Kenneth E. Warner, Eds. Natl Academies Press, Washington, DC. 2009. Graphic used with permission.**

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

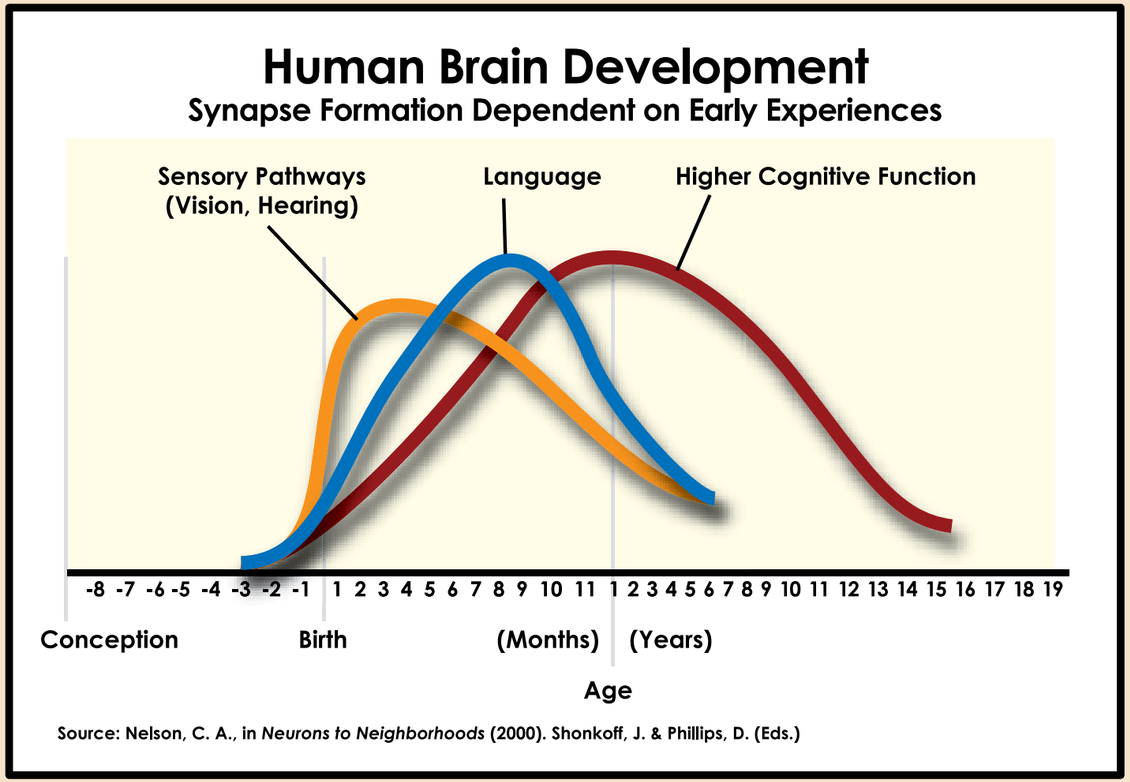
BRAIN DEVELOPMENT

The pattern of formation of nerve connections (synapses) in the cerebral cortex is characterized by rapid proliferation and over-production of synapses, followed by a phase of synapse elimination (pruning) that reduces the number of synapses to more adult-like levels.

This process is prominent in the first years of life, although it extends to some degree into adolescence. However, different brain regions with different functions develop on different time courses.

"Core Concepts in the Science of Early Childhood Development" Harvard Univ. Center for the Developing Child

Experience-dependent synapse formation



Graphic: "A Science-Based Framework for Early Childhood Policy" Center on the Developing Child, Harvard University
Reproduced with permission.

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

Dr. Bradley discussed some of the ways that Gloria and Darrell could help Amelia with her learning problems and discussed eligibility that would allow support for Amelia to attend special programs.

She encouraged them by saying that it was never too late to focus on habits to promote health for the whole family, like healthy eating, exercise, avoiding toxic chemicals, and trying to deal positively with stress.

She referred them back to Mr. Richards at the school to discuss developing a school program tailored to Amelia's needs.

She gave them some booklets and brochures. Amelia's parents thought Dr. Bradley was helpful but left feeling a little overwhelmed.

Amelia was worried because she figured there was extra school work in her future.

+ Healthy eating habits

+ Effect modifiers: iron deficiency, poverty, lead exposure.

+ Resources to help parents:

Learning Disabilities Association

Watch: Dr. Mark Miller describes how lead and stress affect brain functioning, and the benefits of an enriched environment. (4 min.)

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Effect modifiers – Iron deficiency, poverty, lead exposure

Although Amelia has generally had good nutrition throughout her life, many children and families are not able to access nutritious food for many reasons.

For example, nutritious food may not be available or affordable, resulting in "food insecurity." According to the USDA, about 20% of US households with children suffer from food-insecurity. In half of those, only adults were food-insecure (perhaps because the adults go hungry while giving food to their children), while in half both children and adults were food-insecure.

Nutritional deficiencies can have significant adverse impacts on child development, including neurodevelopment. All nutrients are necessary for optimal brain development and growth, but some are more important than others. They include protein, iron, zinc, iodine, selenium, folate, vitamin A, choline, and polyunsaturated fatty acids.

Dietary iron deficiency with or without associated anemia is quite common and is a risk factor for impaired cognitive development. Iron-supplemented formula, however, can adversely impact brain development in infants whose iron stores are already adequate as evidenced by high hemoglobin levels (Lozoff et al., 2012). Poverty also adversely impacts brain growth and development. The neurotoxicant lead is also a well-recognized cause of impaired neurodevelopment with adverse impacts on cognition, behavior, and attention. Lead exposure, dietary iron deficiency, and lower socioeconomic status often co-occur, and their impacts may be more than additive.

For example, the consequences of lead exposure can be accentuated by iron deficiency because lead uptake from the intestine and lead deposition in the brain increase. (Hubbs-Tait et al., 2005, Weiss et al., 2006) Similarly, while stressful life events can worsen negative impacts of poverty, nurturing caregiving can help to mitigate them.

These are examples of effect modification.

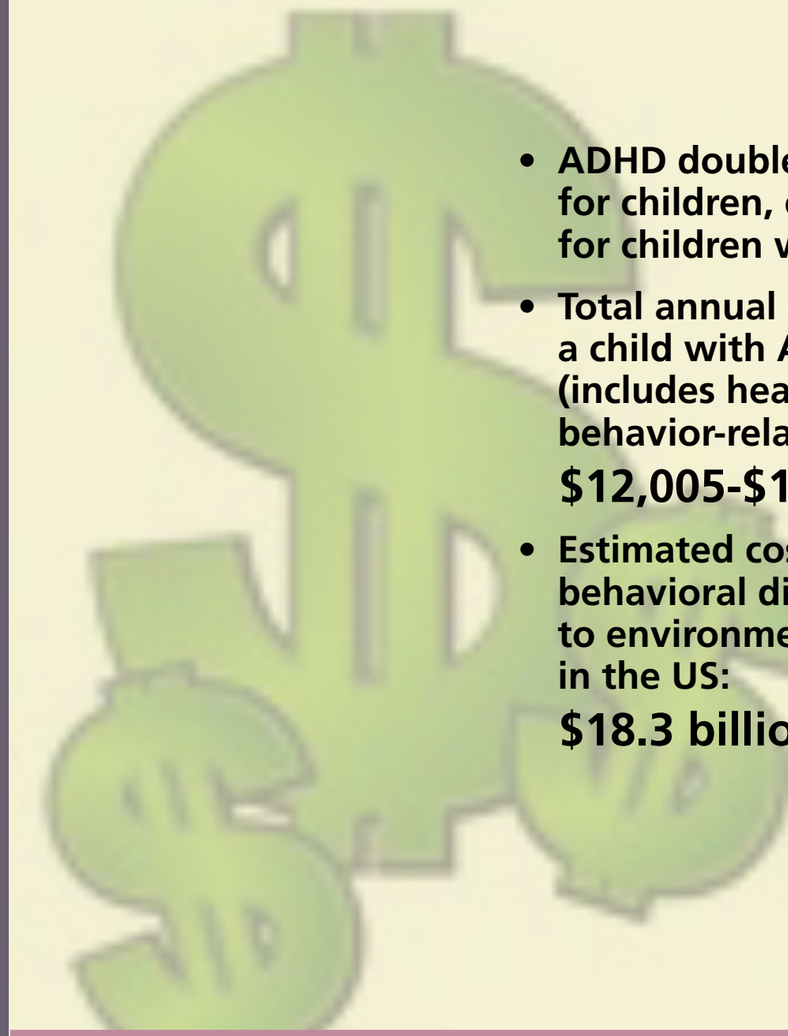
LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

ECONOMIC COSTS

Developmental disabilities affect individuals, families, and communities and have staggering economic costs.

Effects can include:

- academic difficulties,
- employment problems,
- financial stress,
- emotional stress,
- substance abuse,
- lawbreaking , *and even*
- suicide.



- **ADHD doubles health care costs for children, comparable to costs for children with asthma.**
- **Total annual cost-of-illness for a child with ADHD in the US (includes health-, education-, behavior-related costs):**
  $12,005-$17,458/yr.
- **Estimated costs of neuro-behavioral disorders attributable to environmental pollutants in the US:**
  $18.3 billion/yr.

(CDC, National Center on Birth Defects and Developmental Disabilities – ADHD Data and Statistics; Trasande & Liu, 2011)

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

TOXICANTS AND HEALTH

Gloria decided to look online to learn more about environmental chemicals that can contribute to learning and developmental disabilities.

She began to think of the many ways that her family might have been exposed to lead, mercury, pesticides, endocrine disruptors, solvents, air pollution and other substances that she read about.

Chemicals and neurodevelopmental health effects – an overview.

It was not difficult. Before Amelia was born her parents lived in Baton Rouge, Louisiana where Gloria worked at a petrochemical factory. At the factory she had noticed the smell of solvents nearly every day. The smells from the factory were more bothersome when Gloria was dealing with morning sickness.

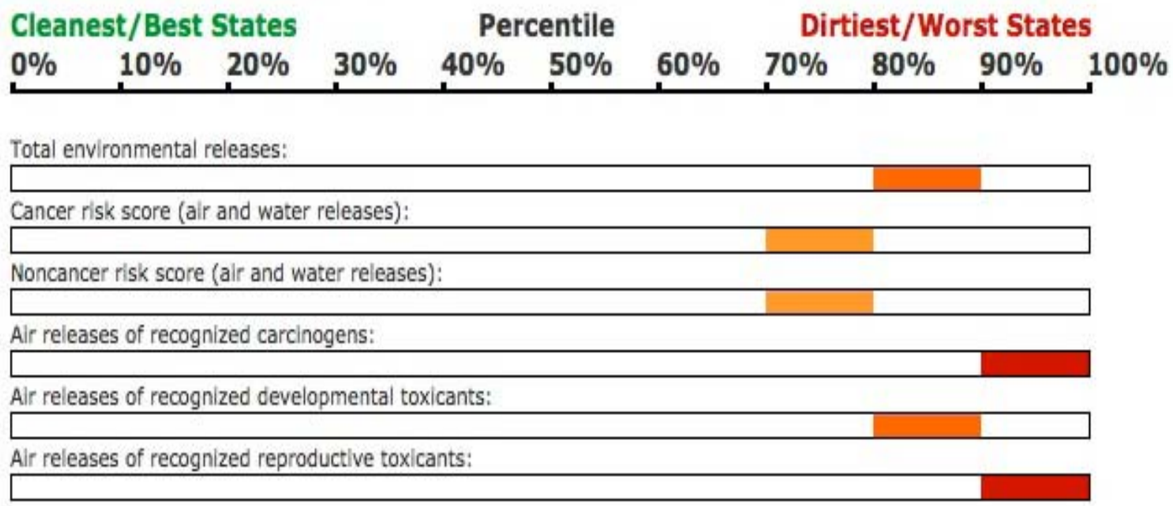
Gloria and Darrell moved to their current home just as Gloria was beginning her second trimester of pregnancy.

Scorecard
THE POLLUTION INFORMATION SITE

Link: Scorecard: Get an in-depth pollution report for your county, covering air, water, chemicals, and more.

Link: California Proposition 65 - chemicals known to cause cancer or reproductive toxicity

2002 Rankings: Major Chemical Releases or Waste Generation in LOUISIANA*



See how this state ranks on other chemical release and waste management attributes tracked by Scorecard

Graphic used with permission.

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Long-lasting, adverse neurodevelopmental (brain and central nervous sysytem) impacts of prenatal, infant, and/or childhood exposures to lead, alcohol, and methylmercury are well known. They demonstrate the vulnerability of the developing brain to neurotoxicant exposures at levels that have fewer and less severe effects in adults. In recent years, the list of environmental chemicals that can adversely impact brain development at environmentally relevant levels of exposure has grown rapidly. It includes additional metals (e.g., arsenic, manganese), various solvents, some pesticides, and a range of persistent, organic compounds that contaminate the general food supply, among others.

In a recent book, *Only One Chance: How Environmental Pollution Impairs Brain Development—and How to Protect the Brains of the Next Generation*, Dr. Philippe Grandjean provides an updated list of 213 industrial chemicals known to be toxic to the nervous system in adults. Many of these chemicals are present not only in the workplace but also in consumer products and the general environment, resulting in exposure to the general population.

Unfortunately, most of these chemicals have not undergone developmental neurotoxicity testing in laboratory animals, nor have their impacts been examined in epidemiologic studies of developing children. As a result, our ability to estimate the contribution of environmental chemicals to adverse brain development and function is limited. Nonetheless, enough is known from studies of limited numbers of chemicals to justify more routine neurodevelopmental testing of chemicals to which the general population is likely to be exposed.

Grandjean P, Landrigan P. Neurobehavioural effects of developmental toxicity Lancet Neurol. 2014 March;(13):330-338.

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

TOXICANTS AND HEALTH - AIR POLLUTION

When Darrell and Gloria moved from Baton Rouge to a smaller town in Louisiana, they chose their new home because of its affordability. The house was a nice size for the growing family, but it was on a busy street, where many trucks passed on their way to factories in surrounding towns.

Soon after the family moved to their new home, Gloria and Darrell undertook some remodeling. Darrell was very busy with his new job, and Gloria (who was pregnant with Amelia) did most of the painting and had new carpet installed.

It was not until many years after moving that Gloria learned that air pollution from traffic emissions can have adverse effects on child development. She also learned that remodeling projects can involve exposures to chemicals that can harm a developing child's brain.

Air pollution, family stress and nutrition - synergistic effects on brain development.

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Air pollution and neurodevelopment – additional impacts of family stress and sub-optimal nutrition

Exposure to higher levels of indoor and outdoor air pollution during pregnancy has an adverse impact on infant mental development (Bayley Scales of Infant Development) (Guxens et al., 2012; Friere et al., 2010; Perera et al., 2006). In one study, the effect was greater among children whose mothers reported low intakes of fruits and vegetables during pregnancy, suggesting a role for oxidative stress and beneficial effects of antioxidants. (Guxens et al., 2012)

Studies have also identified a significantly increased risk of autism spectrum disorder in children exposed to higher levels of air pollution, mostly from traffic-related sources, during gestation and early life. (Becerra, 2013; Volk, 2013; Roberts, 2013; Volk, 2014)

Except for tobacco smoke, the interactive effects of other kinds of air pollution and maternal stress on human infant neurodevelopment have not been studied. However, a study in mice (Maternal Stress and Effects of Prenatal Air Pollution on Offspring Mental Health Outcomes in Mice; Bolton, et al.) "hypothesized that the addition of maternal stress to the impact of prenatal air pollution exposure would act synergistically in off-spring to impair mental health outcomes, compared with the effects of either exposure alone."

It concluded "that maternal stress during late gestation increases the susceptibility of offspring—particularly males—to the deleterious [negative] effects of prenatal air pollutant exposure, which may be due to a synergism of these factors acting on innate immune recognition genes and downstream neuroinflammatory cascades within the developing brain."

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

TOXICANTS AND HEALTH - PESTICIDES

Gloria recalled that they had the new house sprayed for pests after receiving promotional materials in the mail soon after Amelia was born. Although they do not use pesticides in their home or outside any longer, their neighbors regularly spray their lawns with pesticides. She later learned that pesticides, some of which are neurotoxic and can impair brain development, are widely used.

Gloria also thought about Darrell's job as a carpenter and how he works with a lot of chemicals.

She was amazed at how many exposures to toxic chemicals her family had experienced that she had never thought about before!

Prevention Strategies: Integrated Pest Management

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Prevention Strategies: Integrated Pest Management

Integrated Pest Management: Reducing Use of Pesticides in Homes, Schools and Other Buildings

Integrated pest management (IPM) is an approach to pest control that begins with avoiding the use of pesticides at all unless absolutely necessary. Many non-pesticide techniques can help to keep unwanted pests, like insects and rodents, from your home, lawn and garden, as well as public buildings and spaces.

If pesticides must be employed, preference is given to the least toxic alternatives. According to the EPA, IPM is "an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment. The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace."

Graphic: Bio-integral Resource Center, reproduced with permission.

More Resources:

Pesticides: EPA - Integrated Pest Management

Bio-Integral Resource Center (BIRC)

Pesticide Action Network (PANNA)

Drawing courtesy of the Bio-Integral Resource Center, artist Diane Kuhn

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

TOXICANTS AND HEALTH - MERCURY

Amelia liked to go fishing with her father, who was an avid fisherman. For several years they had enjoyed catching and eating a variety of fish from the local lake.

Gloria remembered Darrell coming home from fishing one day and telling her about a posted fish advisory, warning fisherman not to eat the fish due to contamination from mercury.

The advisory included a state web site where Gloria was able to learn more. She read that mercury, like lead, is a heavy metal that disrupts brain development. She also read about the health benefits of eating uncontaminated fish and about nutritious fish with low contaminant levels available in local supermarkets.

Gloria searched for an alternative place where Darrell and Amelia could continue to enjoy fishing and from which the family could also eat the fish they caught. She found a nearby river where the fish were not contaminated. Amelia was happy that she and her dad could still fish together.

Link: EPA fish advisories

Link: Pediatric Environmental Health Toolkit animation on mercury in fish and children's health

Illustration © Stephen Burdick Design

Photos from EPA: http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/index.cfm, used with permission.

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

TOXICANTS AND HEALTH - LEAD

Finally, Gloria thought about the older houses they had lived in and the lead paint problems. They had been careful to remove the paint properly, but maybe they had not removed it all.

Lead removal from gasoline and other products – a public health success story

Luckily, she didn't have to worry about lead in gasoline anymore. She read about how that was a public health success story and how it had reduced blood lead levels in children.

Lead - developmental effects

Pediatric Environmental Health Toolkit animation on lead exposure and children's health

Link: CDC: Primary prevention of lead exposure

Where is the Lead?

- Formerly used in house paint, gasoline, water pipes, solder in food cans.
- Currently found in imported pottery, some cosmetics, some traditional (indigenous or folk) medicine, older water pipes, older house paint, some types of industrial paint, aviation fuel, car batteries, and bullets.
- Most common sources of exposures: older paint, dust, and water pipes.

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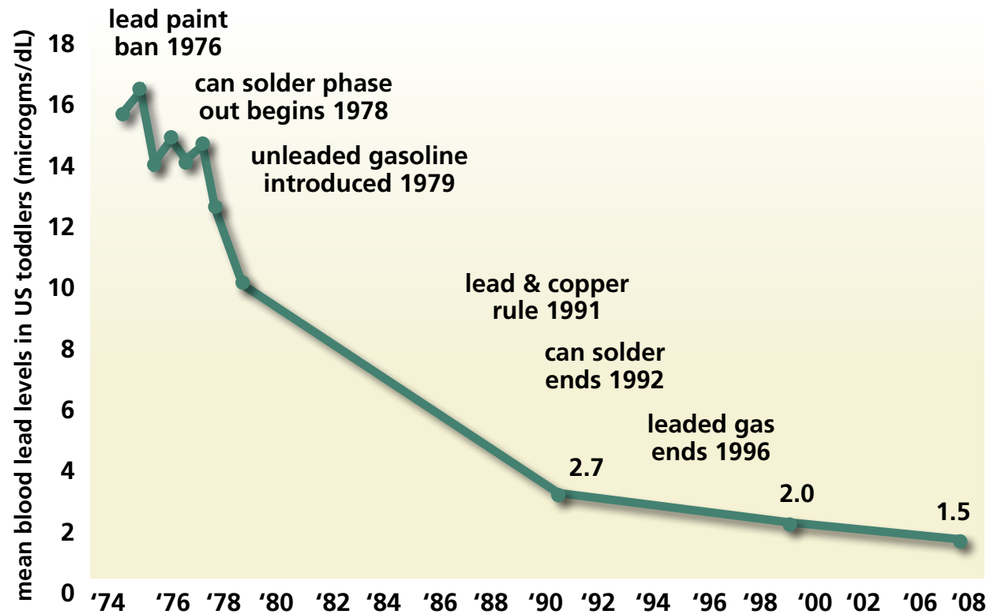
Lead removal – a public health success story

This graph shows declining mean blood lead levels in US toddlers from 16 to 1.5 microgms/dL since the 1970s, corresponding to public health interventions removing lead from various products, including paint and gasoline.

This is an important public health success story. It is an example of what we can do when we prioritize a problem, and address it upstream with policy actions, rather than expecting to solve the problem through individual behavior changes. In this case, some products were reformulated and lead was completely eliminated rather than relying exclusively on attempts to control exposures from lead-containing materials.

Mean blood lead levels in toddlers in the US population 1976-2008



Today elevated blood lead levels remain a problem for a significant number of children, particularly in older housing and urban environments, but the population-wide exposures resulting from air releases have been substantially reduced by removal of lead from gasoline and other products.

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Cognitive and Behavioral Traits Associated with Lead

Traits that Tend to Increase

- Hyperactivity
- Impulsivity
- Distractibility
- Conduct problems
- Difficulty with instructions
- Aggressiveness
- Antisocial behaviors
- Getting off-task

Traits that Tend to Decrease

- Executive function
- Attention/vigilance
- Social skills
- Fine motor skills
- Visual motor coordination
- Academic skills (reading, math, spelling, pattern recognition, and word recognition)

Hearing may be impacted even at very low levels. In adolescents, >2mcg/dl compared to <1mcg/dl lead levels are associated with twice the rate of15dB high frequency hearing loss. High frequency hearing loss may reduce the ability to understand speech and thus may impact many of the traits noted above.

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

TOXICANTS AND HEALTH

Gloria also wondered about other chemicals that she was exposed to when she was pregnant with Amelia, including second-hand tobacco smoke and solvents at the factory where she worked before they moved.

Amelia had thrived in her daycare. She seemed happy there and learned some of the basic skills she needed for kindergarten. Amelia's daycare was a good choice, but Gloria thought about hazardous chemicals Amelia might have been exposed to when she was there.

These include formaldehyde emitted from certain furnishings and building materials like cabinets, hazardous chemicals in carpeting, phthalates in flexible plastic toys and vinyl flooring, bleach and other cleaning solutions, and air pollutants from indoor natural gas combustion.

More information:

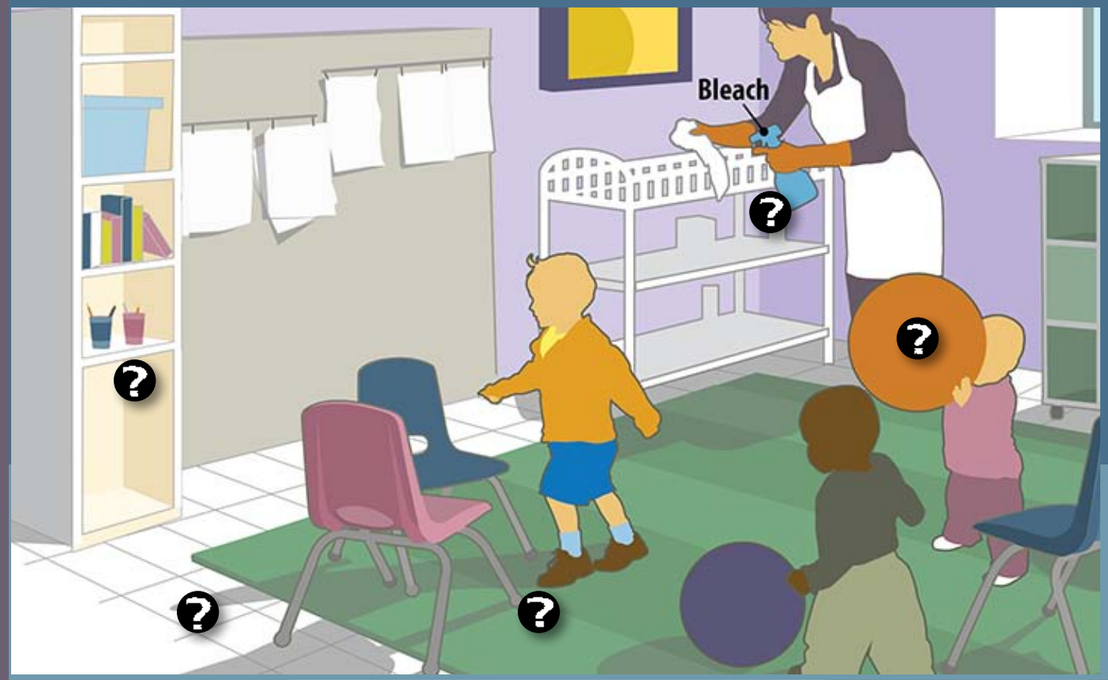
Benefits of early childhood education and policies:

- Benefits of early childhood education
- Early childhood policy

Preventing/reducing toxic chemical exposures in child care settings:

- Eco-Healthy Child Care
- Integrated pest management curriculum and Green cleaning toolkit

Watch: Watch Dr. Mark Miller describes the benefits of early childhood education (1.42 min.)



LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

TOXICANTS AND COMMUNITY HEALTH

Gloria and Darrell became worried that there might not be much they could do about reducing the family's ongoing exposures to hazardous chemicals.

Gloria decided to call up a friend who was involved in the community to see if she knew more about community exposures to toxic chemicals.

Her friend told her there was a local group called "Clean and Green" that was working on reducing the use of chemicals in their town and other issues relating to the environment. She said they had received information from other communities facing similar issues.

Gloria heard the term "environmental justice" for the first time.

Key Concept: Environmental Justice

Watch: Representative Donna Christensen from the U.S. Virgin islands speak about EJ from a physician's perspective. (2.47 min.)

Watch: Peggy Shepard of WE ACT for Environmental Justice addresses "sacrifice zones" at TEDxHarlem (8 min.)

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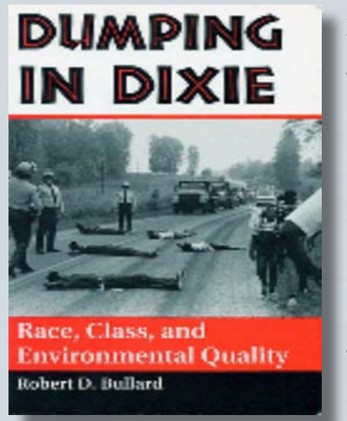
KEY CONCEPT:

Environmental Justice

The modern "environmental justice" or "EJ" movement emerged in 1982 as a result of demonstrations by the residents of Warren County, North Carolina against the dumping of contaminated wastes in their community. Hundreds in this predominantly black, lower income community lay their bodies across the road and were arrested in protest of the trucks' delivery of PCB (polychlorinated biphenyls) contaminated waste to a new dump. Their actions sparked national attention to the issue of race, class, and toxic exposures and a movement of solidarity among civil rights and environmental activists.



"Dumping in Dixie" photo by Jenny Labalme, used with permission.

The United Church of Christ's Commission for Racial Justice landmark 1987 publication, *Toxic Wastes and Race in the United States: A National Report on the Racial and Social Economic Characteristics of Communities of Hazardous Waste Sites*, identified a national pattern of hazardous waste landfills disproportionately located in low income and communities of color in the United States, further catalyzing the national movement for environmental justice. Robert D. Bullard, author of *Dumping in Dixie*, was a leader in this movement.

According to African American Voices in Congress, the origins of the EJ movement may be traced even further back to the Civil Rights Movement of the 1960s. "Low income communities of color emerged as strong activists against what they viewed as environmental attacks on their civil rights."

The U.S. Environmental Protection Agency defines Environmental Justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

Find out more: Toxic Wastes and Race at Twenty: 1987-2007 (pdf)

Read the latest goals for the EPA's national EJ program, "Plan EJ 2014"

Browse maps: Interactive Global Atlas of Environmental Justice

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

TOXICANTS AND COMMUNITY HEALTH

Gloria started attending meetings of Clean and Green.

She learned a lot about the many sources of pollution in the community, in the air, in the water, and on land.

The group had information about environmental contamination and community health studies. They were working with scientists from a nearby university who were considering doing a health study, as there seemed to be higher than expected levels locally of several diseases, including cancer, and concerns that there were excessive numbers of children being born with birth defects.

+ Chemical regulations

+ Community Health Studies

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Chemical Regulations

Federal regulatory laws addressing chemicals have evolved over decades, although some have been more effective than others. The Environmental Protection Agency (EPA) is authorized to regulate pesticides under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA); other industrial chemicals under the Toxic Substances Control Act (TSCA); air pollutants under the Clean Air Act; and water pollutants under the Safe Drinking Water and the Clean Water Acts. Pharmaceuticals, chemicals in food, and cosmetics are under the regulatory authority of the Food and Drug Administration (FDA).

Over 80,000 chemicals are currently in the TSCA inventory. Among its many weaknesses, when TSCA was first passed in 1976, tens of thousands of chemicals on the market were grandfathered and remain in use today with very limited safety data. Moreover, chemical manufacturers are not required to evaluate the safety of new chemicals before notifying the US EPA of their intent to manufacture and market them. And the EPA has very limited authority to require pre-market safety testing. As a result, thousands of chemicals known to be harmful or for which safety data are largely missing are present in consumer products and the general environment. Studies of human blood, urine, hair, or other tissues show that exposures to hundreds of these chemicals are widespread in the general population. Several versions of legislation to reform TSCA have been introduced in Congress in the past several years, but none has been adopted. Some states have enacted laws intended to restrict, phase out, or label certain hazardous chemicals. They include California's Proposition 65, which requires warning labels on products containing chemicals known to cause cancer or reproductive disorders, and also prohibits discharge of these chemicals into drinking water sources. Washington state has adopted a plan to phase out of commerce certain persistent, bioaccumulative, toxic chemicals. California has also enacted a green chemistry law that will slowly require safer alternatives for a few chemicals in consumer products.

Links for more info:

+ Safer Chemicals Healthy Families

+ EPA: Laws and Executive Orders

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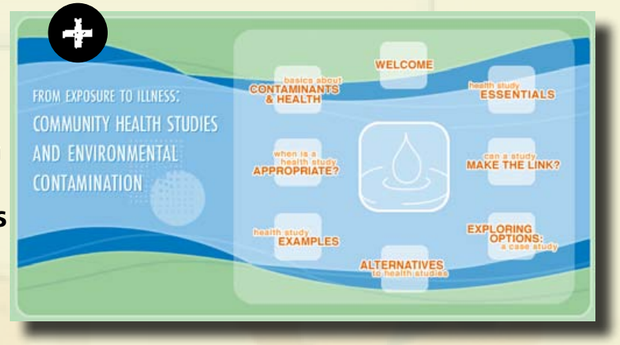
Chemical regulations

Community Health Studies

Community Health Studies and the Environment

Citizens concerned about pollution in their community, or about apparent high levels of diseases like cancer, sometimes turn to scientists and health experts to ask them to study their town to see if there are connections between pollution and their health. These studies are difficult and expensive, and citizens are often disappointed in the results.



Find out why with these two resources.

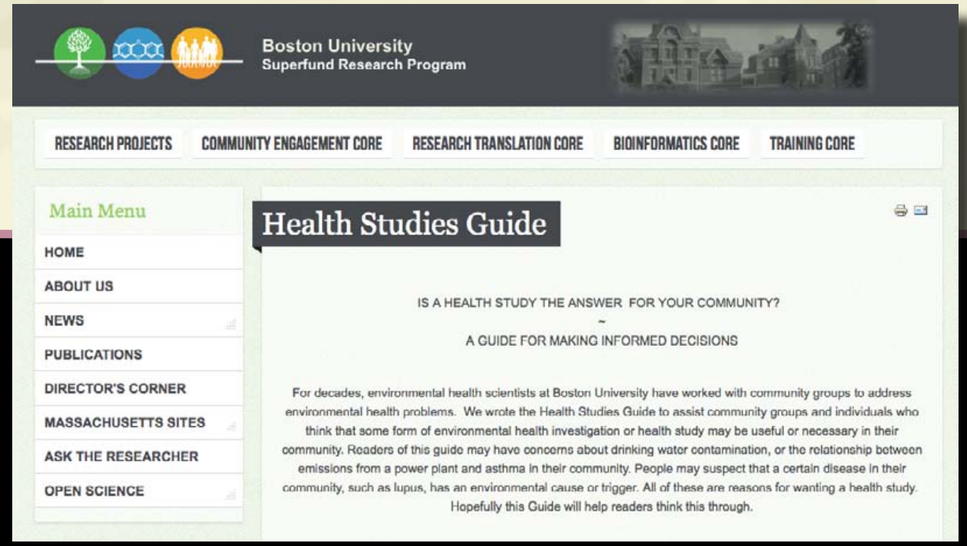
HEALTH STUDIES GUIDE: Boston University Superfund Research Project

A guide for making informed decisions, written to assist community groups and individuals who think that some form of environmental health investigation or health study may be useful or necessary in their community.

FROM EXPOSURE TO ILLNESS: Community Health Studies and Environmental Contamination

The Environmental Health Investigations Branch, California Department of Public Health

Created as a means to share the experience and perspective of public health staff dedicated to studying links between environmental exposure to chemicals and health effects in California communities.



LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

The next time Amelia went to her new family practice for a checkup, Gloria told them about Amelia's diagnosis of a learning disability.

Her nurse practitioner, Robert, suggested some things to do that could help Amelia.

They included making sure she got enough exercise, adequate sleep, healthy and nutritious foods, and encouragement to spend time outdoors in green space or natural surroundings, such as in the park, because that could help her with her attention and focus.

Benefits of spending time in green space or natural surroundings on cognition and general health.

Link: Animation on "Healthy Food and Exercise" – UCSF Pediatric Environmental Health Specialty Unit.

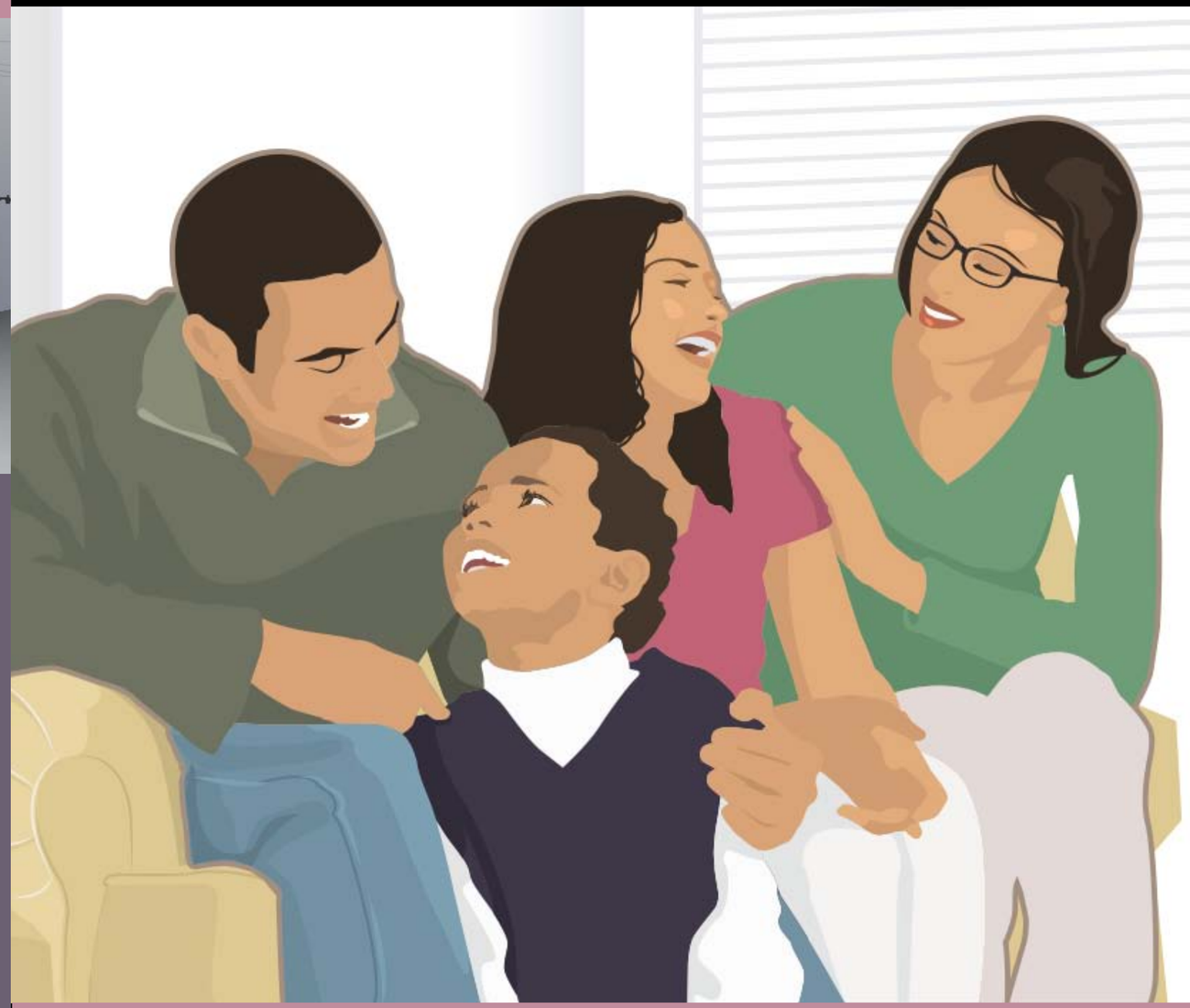
LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

Amelia's parents both became involved in the community group. Over the years they had some major successes, including getting the truck route that used to go by their house changed to a less residential area. They knew that would promote the health of their entire family and community.

The education plan that the school, the developmental pediatrician, and Amelia's parents put together included learning strategies for reading and math that Amelia found helpful.

Amelia still struggles to some extent with particular tasks in school and can sometimes become frustrated in social situations, but she knows she has the support of her family and friends and that means a lot.

Her parents know they are doing everything they can to improve the health of their family.



LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

Throughout the pages of Amelia's story we've seen a wide range of interacting factors across her lifespan that may have increased her risk for developmental disabilities.

These include exposure to toxic chemicals and community stressors, diet, socioeconomics, genetics, and gene-environment interactions.

We have also seen factors that can increase resilience and enhance healthy development, such as parental love and attention, childhood enrichment activities, and early childhood education.

Although Amelia's story is fictional, children throughout our country face a similar range of issues and circumstances. Developmental disabilities are widespread. It is critical that we consider the multiple environmental influences associated with increased risks of developmental disabilities, and their long term consequences for children like Amelia, when we design prevention strategies and treatments to address them.

Continue to Final Thoughts >

A wide range of interacting factors across Amelia's lifespan may increase the risk for developmental disabilities

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It is critical that we consider the multiple environmental influences associated with increased risks of developmental disabilities, and their long term consequences for children like Amelia, when we design prevention strategies and treatments.

SOME FINAL THOUGHTS

COMMON THEMES

Although the fictional narratives in *A Story of Health* describe the lives of people with different diseases, common themes resonate. They include:

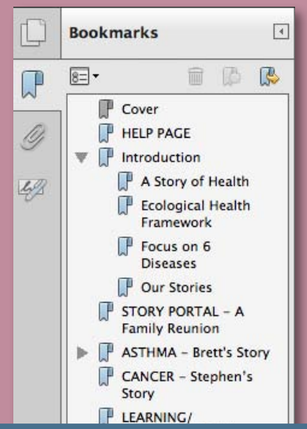
- Important environmental influences come from the natural, chemical, food, built, and social environments.
- Although there are exceptions, most diseases as well as good health are the result of complex interactions among multiple environmental influences and genetics.
- Early-life experiences, particularly during critical windows of development, can have profound beneficial or detrimental lifelong effects, even into elder years.
- Preventing disease and promoting health require actions and commitments from the individual, family, community and society, as they are all interconnected.

- **Common themes in stories**
- **Additional Resources**
- **Register for Continuing Education Credits**

We'd love to hear from you. Give us your feedback on *A Story of Health*. Click here!

Resources

We have linked to many useful resources in each story relevant to a wide range of audiences, including clinicians. To quickly access resources on specific topics in each story, use the **Bookmarks** toolbar on the left (which you can open or close), or return to the **Help page** for more details on other eBook features.



Additional resources to help prevent disease and promote health:

Portal to Science Resources: Hundreds of additional resources on environmental health including organizations, publications, videos and more.

Pediatric Environmental Health Toolkit: Materials for health care providers and patients in English and Spanish.

Out of Harm's Way: Preventing Toxic Threats to Child Development: Fact Sheets in English and Spanish.

Approaches to Healthy Living: A 4-page guide on how to avoid toxicants, eat healthier, reduce stress.

Healthy Aging: The Way Forward: An ecological approach to policy level interventions for healthy aging across the lifespan.

Continuing Education

Register for Continuing Education (CE) credits for *A Story of Health* for a variety of health professions. Free credits are offered by the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry at this link.

Another free CE course on environmental health offered by the CDC/ATSDR is the **Pediatric Environmental Health Toolkit** online course.

REFERENCES: Learning/Developmental Disabilities

Asthma

Childhood Leukemia

Learning/ Developmental Disabilities

Diabetes

Infertility

Cognitive Decline

Developmental and Learning Disabilities Case References and Resources by Topic

Note: there are many topic overlaps

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Learning/ Developmental Disabilities

Diabetes

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ASTHMA: Brett's Story (a fictional case)

Brett is a nine year old boy who lives with his mom, Karen in an urban area in southern California. They live in an apartment near a busy street, and Brett takes the bus to public school. He plays several sports including baseball, soccer, and basketball, and likes to go out with his friends. Unfortunately, today, many kids like Brett also have asthma.

Basic information: Click here to find out more about asthma.

Health professionals: Click here to read more about asthma.

Asthma resources and more information from the CDC .

CHILDHOOD LEUKEMIA Stephen's Story*

Stephen is a 3-year-old boy who lives with his parents David and Tricia in a suburb in Connecticut.

He is an only child, and his parents spend as much time as they can with him even though they manage a successful plant nursery and garden center.

He spends four days a week at child care and is with his parents the other three days, sometimes at their house and sometimes at the garden center.

Stephen had been an active toddler, but during the past month, Tricia noticed that Stephen was not as lively and energetic as usual. His child care providers also mentioned this.

When he became listless and started to run a fever, Tricia became concerned. She took Stephen to see his pediatrician, Dr. Jones.

(*a fictional case)

DIABETES Marcela's Story

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Basic information: (to come)

Health professionals: (to come)

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STORY IN DEVELOPMENT

INFERTILITY Toshio & Reiko's Story

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COGNITIVE DECLINE Donald's Story

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