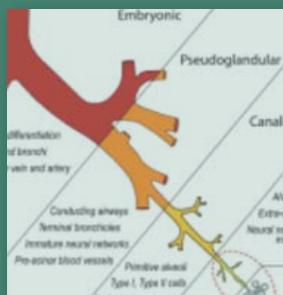
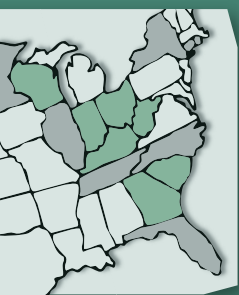


A Story of Health

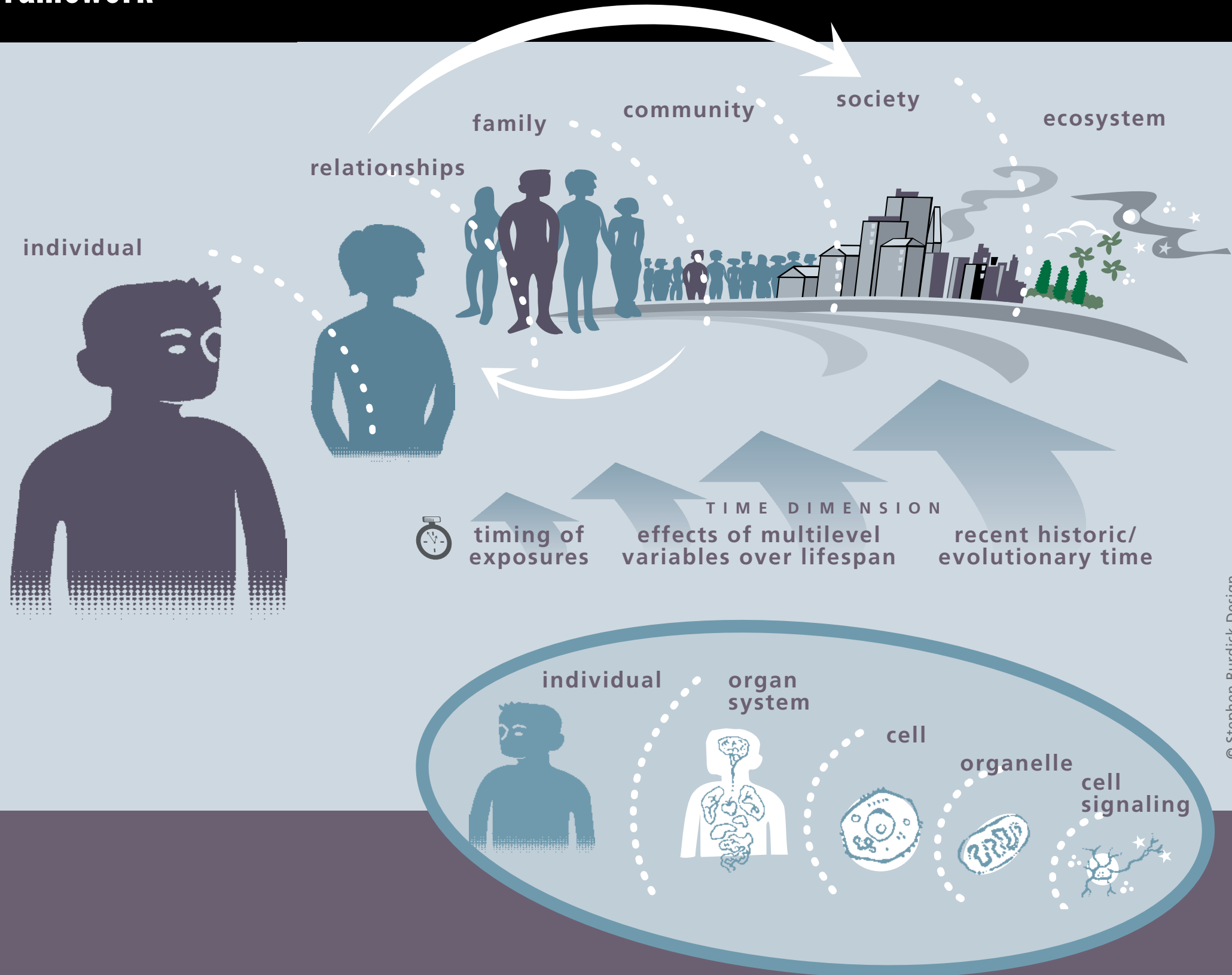


INTRODUCTION Ecological Health Framework

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.

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)

LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

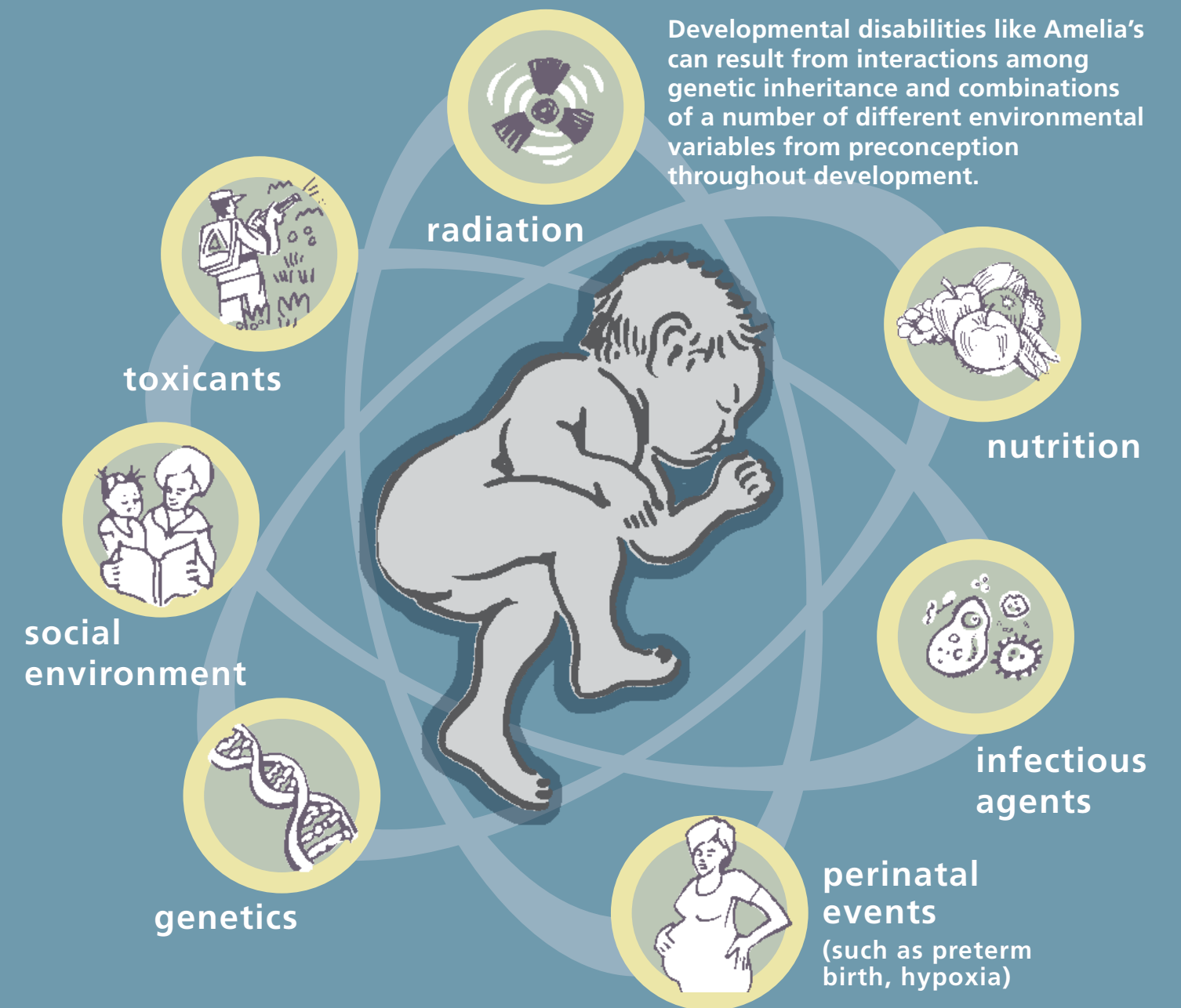
A single variable, such as birth trauma or prenatal exposure to alcohol, may sometimes be the cause of a developmental disability. More commonly, however, multiple risk factors combine to alter brain development and/or function in a variety of ways, resulting in a developmental disability.

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



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.

Checklists for Parents:
[CDC's Developmental Milestones by specific age](#)

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



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.

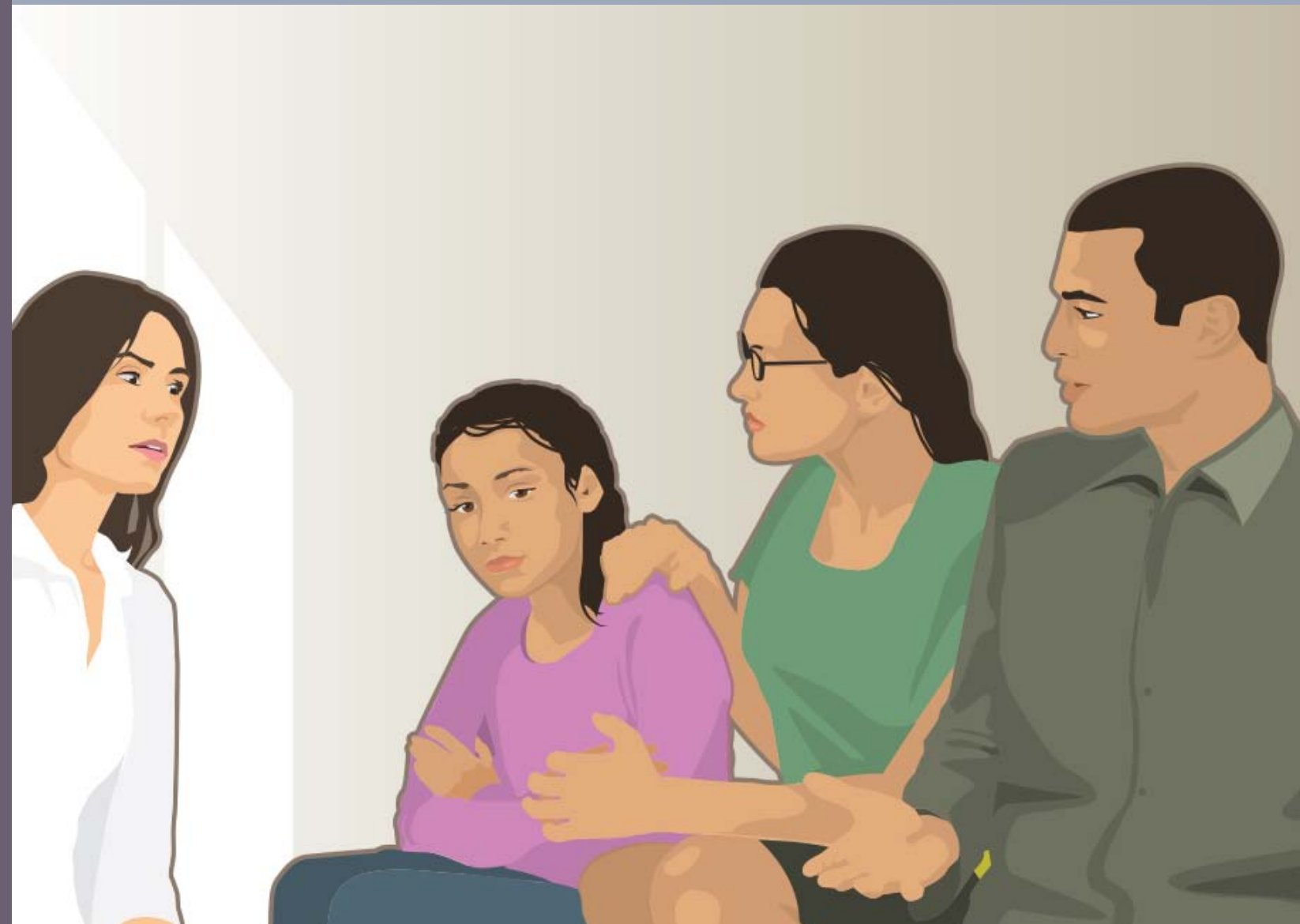
The medical setting was somewhat intimidating at first, but the people at the center made them feel at ease. They were introduced to Dr. Bradley, a developmental pediatrician, who said she would be conducting a number of screening procedures with Amelia.

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](#)



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.

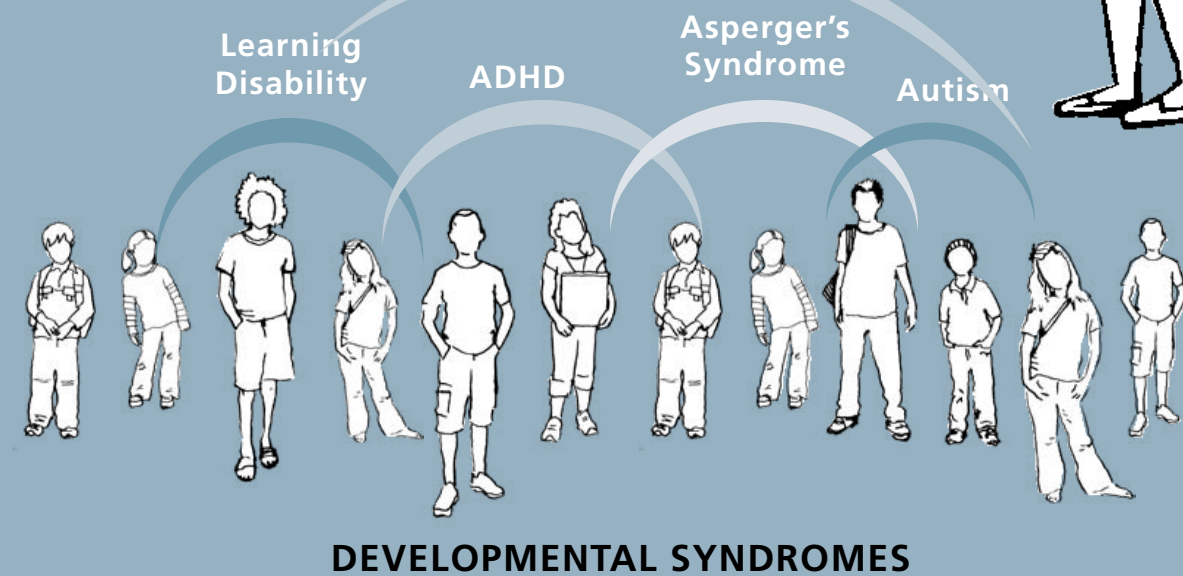
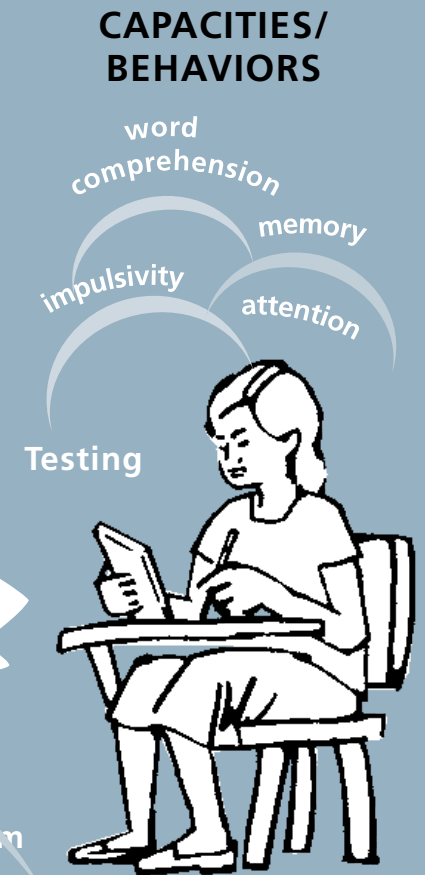
ADHD is also frequently associated with autism spectrum disorder, obsessive compulsive disorder, tic disorders, and intellectual disabilities.

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

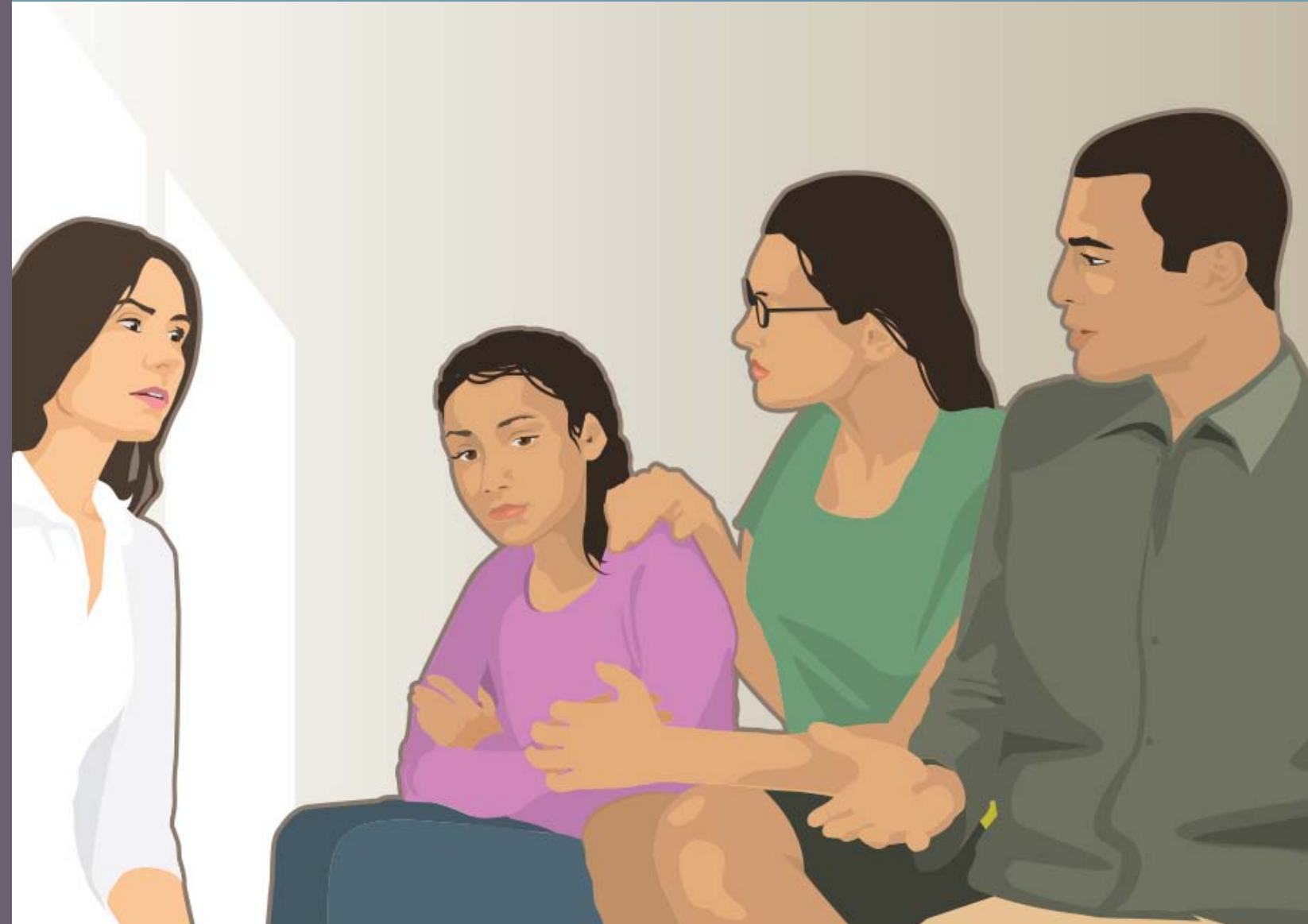
Folate supplementation recommendations for women



A Rationale for Thyroid Screening



For Clinicians: Prenatal environmental health history form, [PEHSU Region 5](#)



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.



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.)



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.

+ [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](#)

Chemicals and neurodevelopmental effects: an overview

Long-lasting, adverse neurodevelopmental (brain and central nervous system) 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.



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**



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](#)



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.



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:

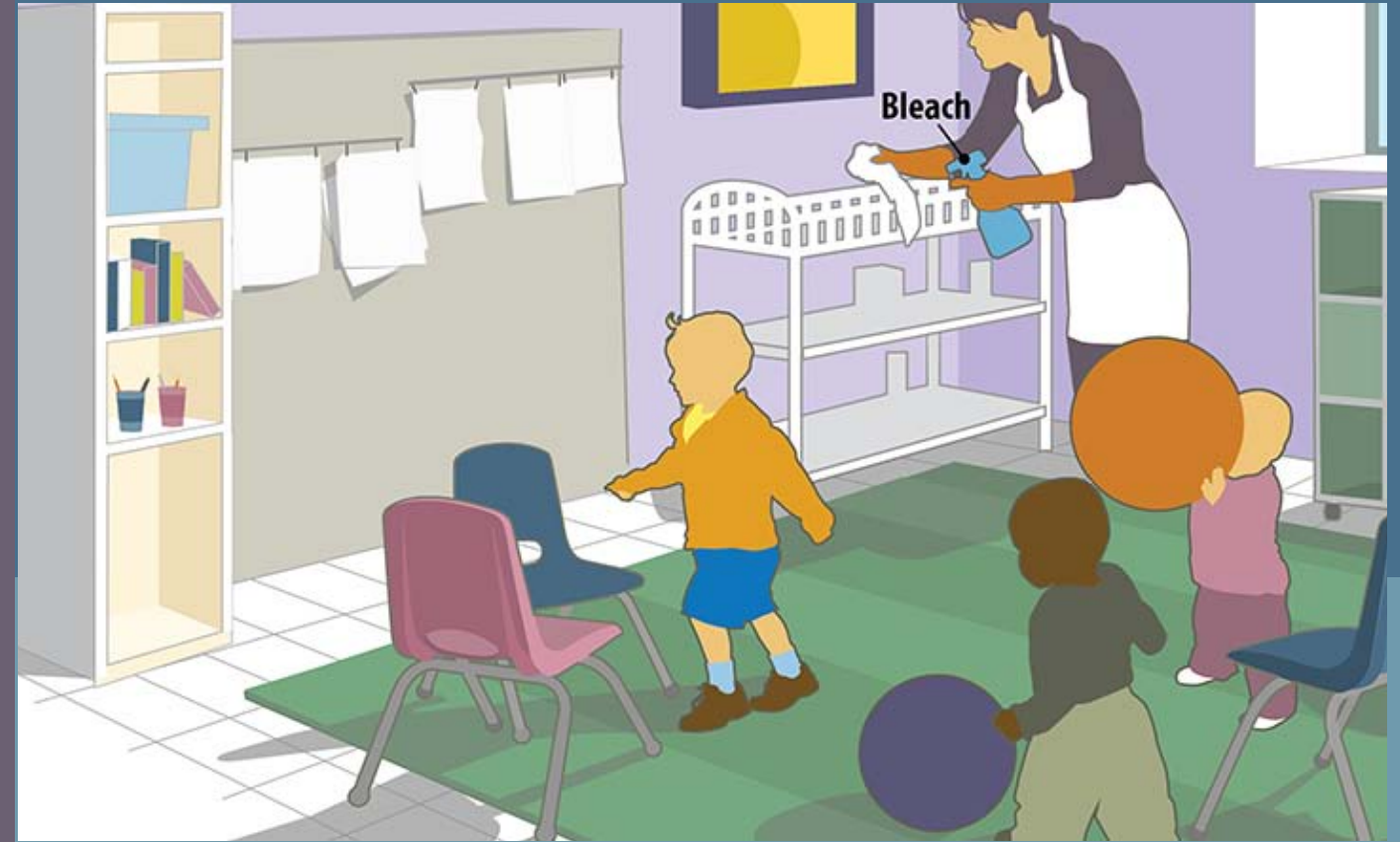
- [Benefits of early childhood education](#)
- [Early childhood policy](#)

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.)



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



LEARNING/DEVELOPMENTAL DISABILITIES Amelia's Story

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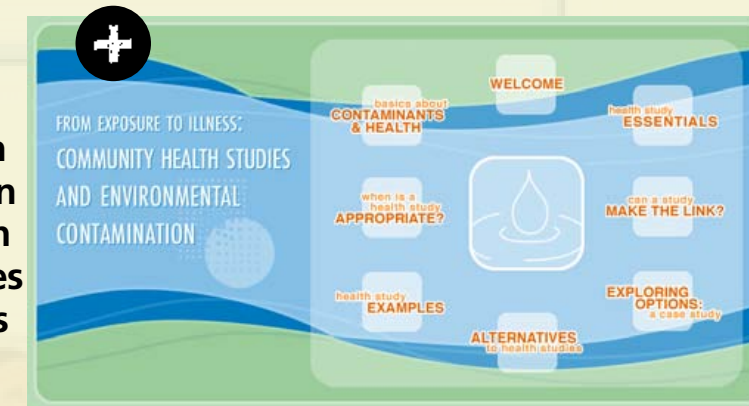
Chemical regulations



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.

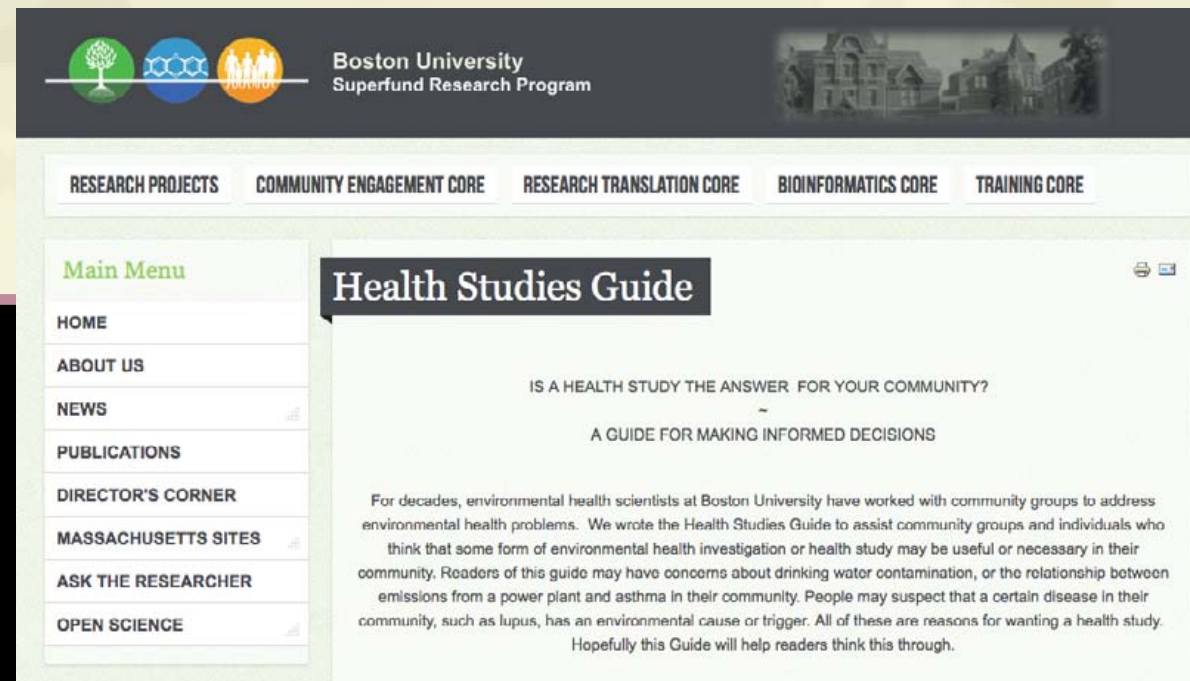
HEALTH STUDIES GUIDE: Boston University Superfund Research Project

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.



Graphics used with permission.

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.



[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](#) >



Children throughout our country face a similar range of exposures and consequences.



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



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.



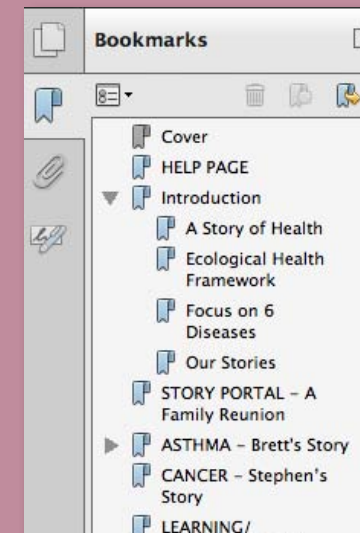
- Common themes in stories
- Additional Resources
- Register for Continuing Education Credits



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.

Asthma

Childhood
LeukemiaLearning/
Developmental
Disabilities

Diabetes

Infertility

Cognitive Decline

Developmental and Learning Disabilities Case References and Resources by Topic

Note: there are many topic overlaps

ADHD

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