

# Artificial Turf and Children's Health

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June 28, 2022



**Mount  
Sinai**

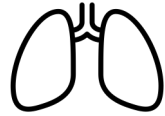
# Chronic diseases are on the rise

Your lifetime risk has doubled or tripled for many common diseases in the past 20 years



**1 in 10**

**Alzheimer's Disease**



**1 in 12**

**Asthma**



**1 in 44**

**Autism**



**1 in 3 / 2**

**Cancer in Women/Men**



**1 in 12**

**Cardiovascular Disease**



**1 in 6**

**Developmental Disabilities**



**1 in 10**

**Diabetes**



**1 in 10**

**Food Allergy**



**1 in 10**

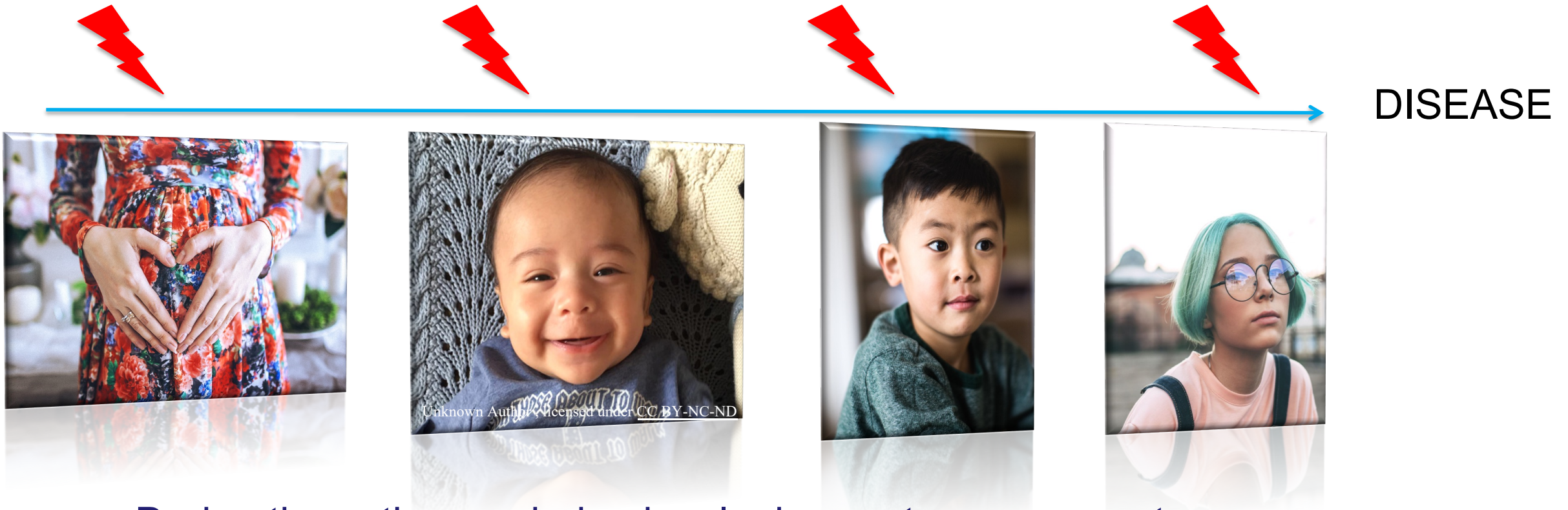
**Infertility in Couples**

# Overview

- Vulnerable populations
- Chemicals of concern
- Heat
- Injuries and abrasions
- Tips for safer play

# Windows of Susceptibility

Not just *what*, but *when*



During these time periods, developing systems are most sensitive to certain environmental toxins.



# Children are not little adults



This Photo by Unknown Author is licensed under CC BY-NC

# Our Chemical Body Burden



- 200+ chemicals
- Some exposures higher in children
- Higher exposures in Black and Hispanic participants
- Chronic, low-dose + cumulative
- Clinical relevance?

<https://www.cdc.gov/nchs/nhanes/>

# Chemicals of Concern in Turf

## Carcinogens

- Benzene
- PAHs
- Styrene
- Cadmium
- Arsenic
- PFAS
- VOCs

## Neurotoxicants

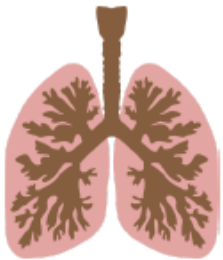
- Lead
- Zinc
- Phthalates
- VOCs

## Reproductive Toxicants

- Phthalates
- Plasticizers

## Respiratory Irritants

- VOCs
- Particulate matter
- Silica



Inhalation of chemicals and particles



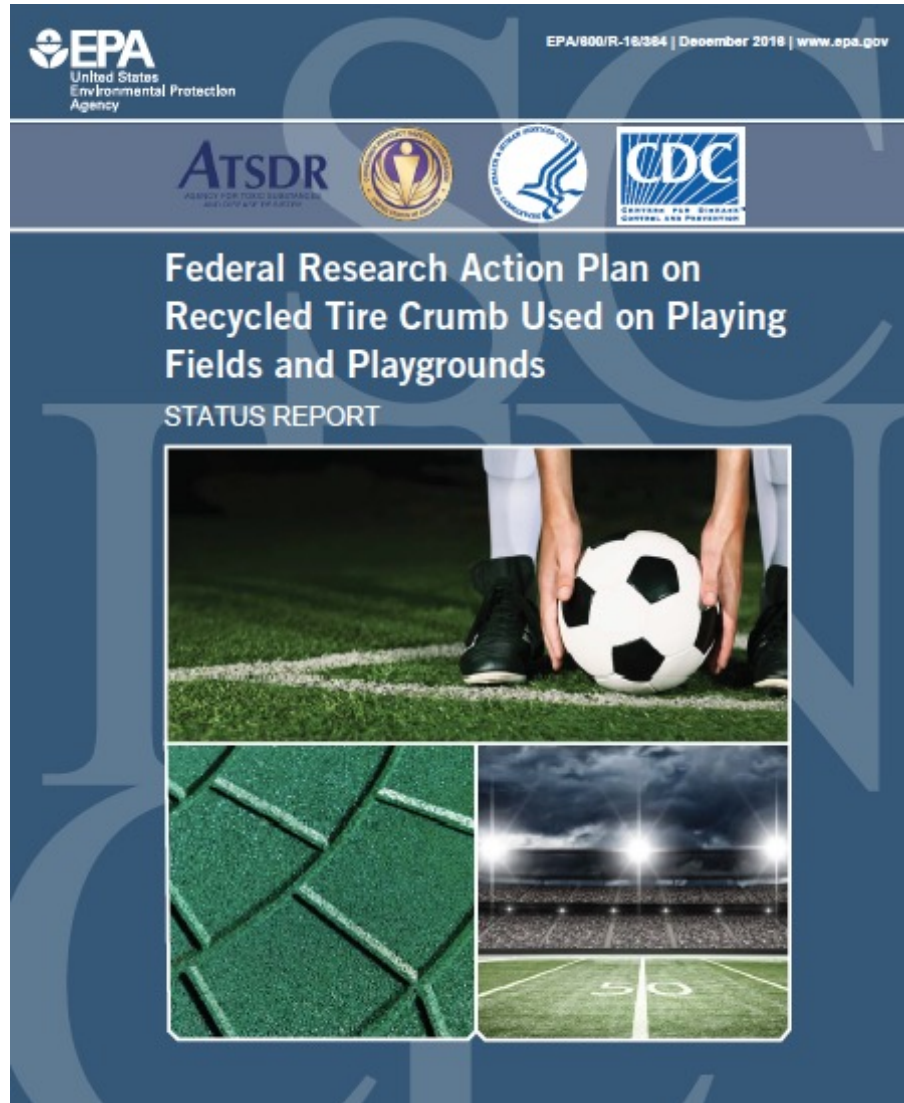
Dermal contact and absorption through the skin or open wounds



Ingestion of turf infill particles



# Federal Turf Study



**“Studies to date...have limitations and do not comprehensively evaluate the concerns about health risks from exposure to tire crumb rubber.”**

# Alternative Infills Contain Chemicals of Concern

**Table 1.** Comparing Tire Crumb With Alternative Infills: Selected Categories of Chemicals of Concern.<sup>a</sup>

Category	Tire crumb	EPDM	Shoe materials <sup>b</sup>	TPE	Acrylic-coated sand	Mineral- or plant-based
VOCs	Present <sup>c</sup>	Present; lower in some cases, higher in others <sup>d</sup>	Expected to be present but subject to RSL	Present, lower <sup>e</sup>	Expected to be low or absent	Expected to be low or absent <sup>f</sup>
PAHs	Present <sup>c</sup>	Present, lower <sup>d</sup>	May be present but subject to RSL	Present, lower <sup>e</sup>	Below detection limit <sup>g</sup>	Expected to be low or absent <sup>f</sup>
PAHs (TURI sample) <sup>h</sup>	Present, highest	Present, lower <sup>LI</sup>	Present, lower <sup>LI</sup>	Present, lowest <sup>L2</sup>	Present, lowest <sup>L2</sup>	Present, lowest <sup>L2</sup>
Phthalate esters	Present <sup>c</sup>	Present, lower <sup>d</sup>	May be present but subject to RSL	Present <sup>e</sup>	Expected to be absent	Expected to be absent
Vulcanization compounds <sup>i</sup>	Present <sup>c</sup>	Expected to be present	Expected to be present	Expected to be absent	Expected to be absent	Expected to be absent
Vulcanization compounds: benzothiazole only (TURI sample) <sup>h</sup>	Present, highest	Present, lowest detected <sup>L3</sup>	Present, lower <sup>LI</sup>	Not detected	Not tested	Not tested
Lead <sup>j</sup>	Present, wide range of values documented in the literature <sup>c</sup>	Present, lower in some cases, higher in others <sup>d,i</sup>	Present	Present	Below detection limit <sup>g</sup>	Below detection limit in some cases
Other metals <sup>j</sup>	Present	Present	Present	Present	Present <sup>g</sup>	Present in some cases
Fungi, allergens, or other biologically active dusts	Not known to be present	Not known to be present	Not known to be present	Not known to be present	Not known to be present	May be present in some plant-based materials
Pulmonary fibrogenic dusts (crystalline silica or respirable fibers)	Not known to be present	Not known to be present	Not known to be present	Not known to be present	Not known to be present	May be present in some mineral-based materials <sup>k</sup>

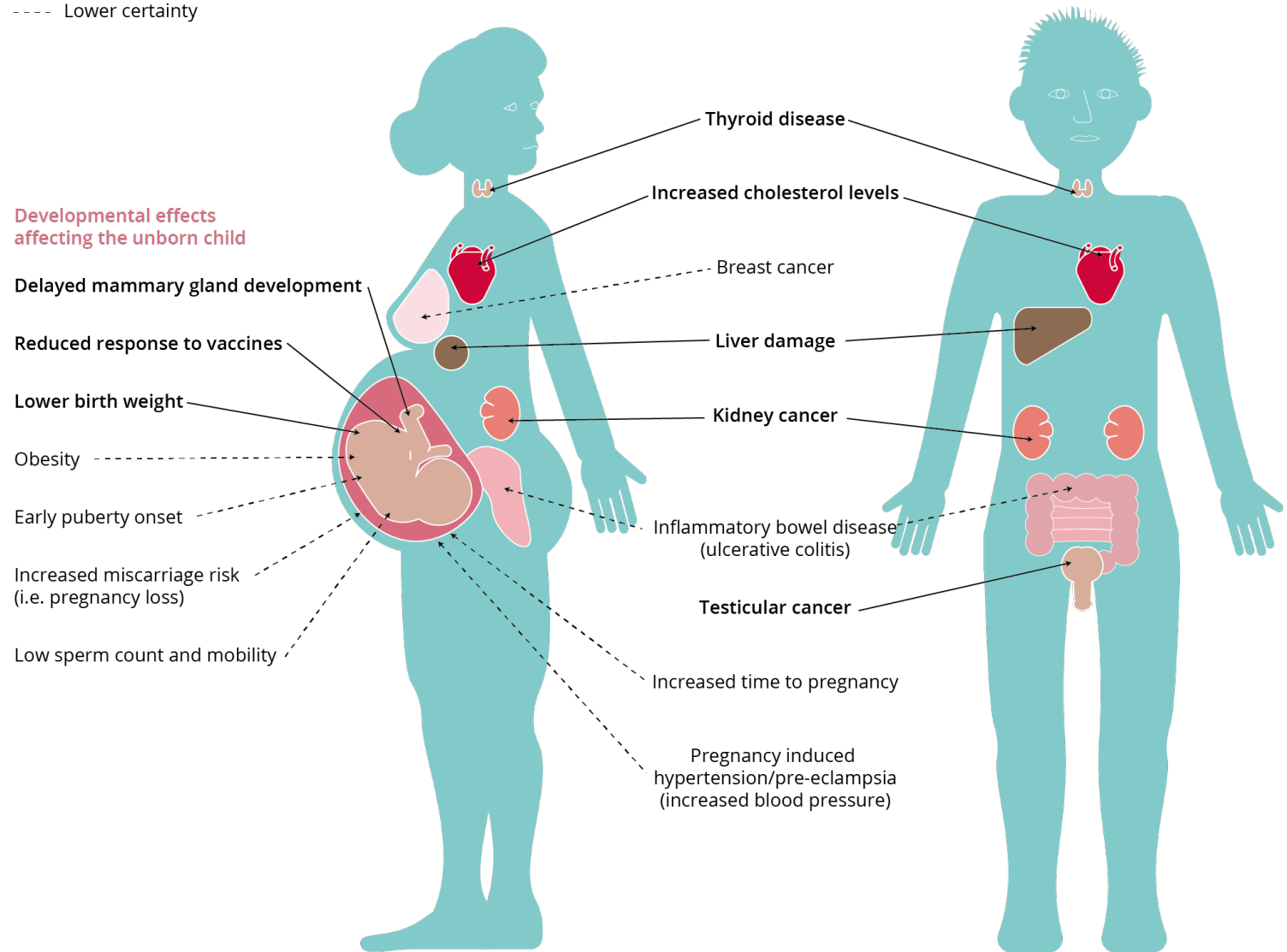
Massey et al. Artificial Turf Infill: A Comparative Assessment of Chemical Contents. *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy*. 2020, Vol. 30(1) 10–26.

See also Armada et al. Global evaluation of the chemical hazard of recycled tire crumb rubber employed on worldwide synthetic turf football pitches. *Science of the Total Environment* 812 (2022) 152542.

# Non-infill exposures: PFAS

- High cholesterol
- Thyroid disease
- Ulcerative colitis
- Cancer
  - Kidney
  - Testicular
- COVID-19 severity
- Immune dysfunction
  - Decreased vaccine response
- Impaired neurodevelopment
- Pregnancy outcomes

— High certainty  
- - - - Lower certainty



# PFAS: Research to Action

## Senate Bill S439A

SIGNED BY GOVERNOR

2019-2020 Legislative Session

Relates to reducing the use of PFAS chemicals in firefighting activities

## Senate Bill S8817

SIGNED BY GOVERNOR

2019-2020 Legislative Session

Relates to the use of perfluoroalkyl and polyfluoroalkyl substances in food packaging

## Senate Bill S1759A

SIGNED BY GOVERNOR

2021-2022 Legislative Session

Relates to establishing a list of emerging contaminants

## Assembly Bill A8491

2021-2022 Legislative Session

Phases out the sale of products that contain intentionally added PFAS

## Senate Bill S6291

2021-2022 Legislative Session

Prohibits the use of perfluoroalkyl and polyfluoroalkyl substances in common apparel

News Releases: [Headquarters](#) | [Water \(OW\)](#)

[CONTACT US](#)

## EPA Announces New Drinking Water Health Advisories for PFAS Chemicals, \$1 Billion in Bipartisan Infrastructure Law Funding to Strengthen Health Protections

Agency establishes new health advisories for GenX and PFBS and lowers health advisories for PFOA and PFOS

June 15, 2022

### Interim Drinking Water Lifetime Health Advisories\*:

PFOS: reduced from 70 ppt to 0.02 ppt

PFOA: reduced from 70 ppt to 0.004 ppt

GenX: 10 ppt

PFBS: 2000 ppt

*\*Non regulatory, non enforceable*



# Emerging Concern: Microplastics



Microplastics in house dust. Credit : Universiteit Utrecht



- Indoor & outdoor air
- Tap and bottled water
- Seafood
- Inhale and ingest 5g/week
- Lung, blood, placenta
- Health effects may include:
  - Inflammation
  - GI problems
  - Obesity/metabolic disorders
  - Respiratory problems
  - Immune dysruption
  - Endocrine disruption

# Heat effects of turf



**Thermal effect.** An image taken 14 August 2002 by NASA's Landsat satellite (left) shows surface temperatures in upper Manhattan (red indicates warm temperatures, and blue indicates cool temperatures). A large synthetic turf field created high temperatures similar to those on a large black roof (see Google Earth image, right). Cool spots almost always correspond to urban vegetation, such as parks, street trees, and water bodies.

- Surface temperatures up to 200°F
  - 50°F higher than natural grass
  - 70°F hotter than air temp
- Increased air temperature at head height
- Watering provides limited cooling



# Surface Temperature in Turf Field and Playgrounds

## Crumb Rubber Infill Turf Field

Ambient temperature: 80°F

Surface temperature: 101.9°F

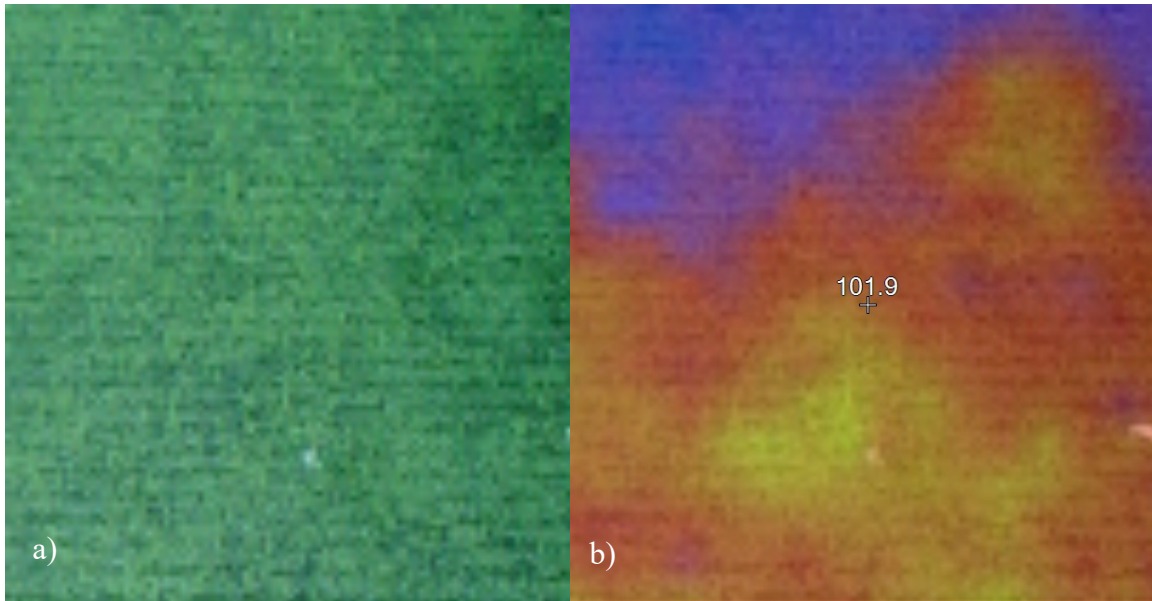


Figure. Measurement of Crumb rubber Turf Field Surface Temperature with Infrared (IR) Thermometer: a) Image of crumb rubber playground surface; b) IR Thermal image of surface. Ambient temperature: 80°F

## Crumb Rubber PIP Playground

Ambient temperature: 85°F

Surface temperature: 157.4°F

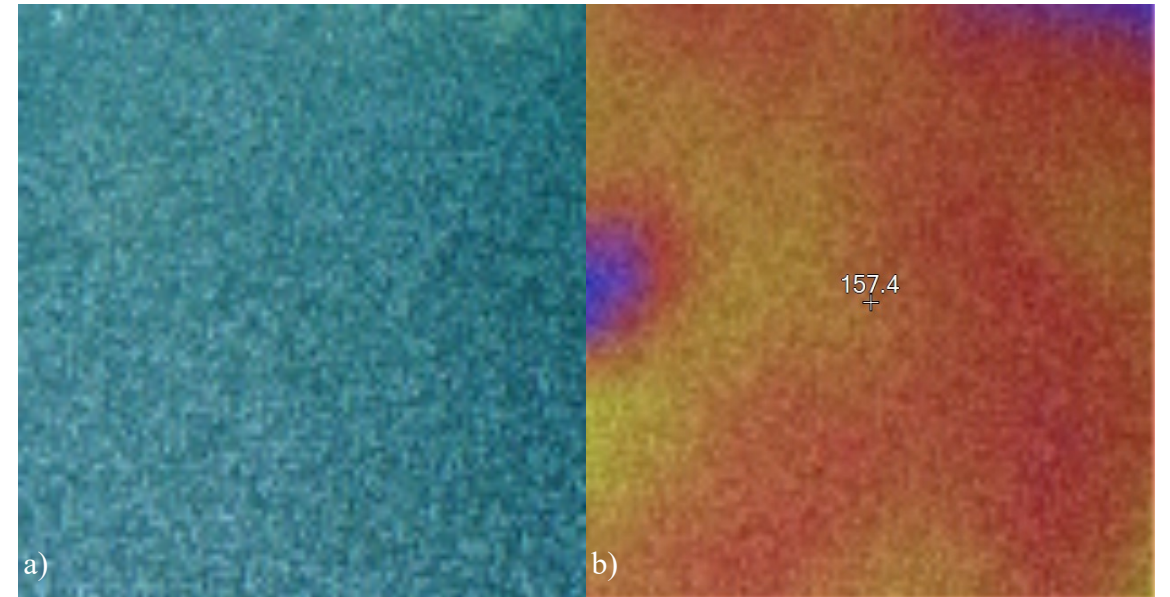


Figure. Measurement of Playground Surface Temperature with Infrared (IR) Thermometer: a) Image of crumb rubber playground surface; b) IR Thermal image of surface. Ambient temperature: 85°F

Courtesy: Homero Harari, Mount Sinai

# Health effects of hot turf

- Heat illness

- #1 cause of death and disability in high school athletes
- Football players most impacted
- Marching bands also at risk

- Skin burns

- 1<sup>st</sup> degree: 118°F
- 2<sup>nd</sup> degree: 131°F





# Injuries and Abrasions

- Knee injuries
  - ACL, PCL
- Concussion
  - Temperature and maintenance are key
- “Turf burn”
  - Skin abrasion
  - May increase risk of chemical exposures
  - Increases risk of infection include MRSA



INSIDER

## NFL stars started a petition to ban artificial turf in football after Odell Beckham's Super Bowl injury

Jackson Thompson

February 14, 2022 · 4 min read

In this article:



San Francisco 49ers  
NFL | 3rd NFC West | 10-7-0



Los Angeles Rams  
NFL | 1st NFC West | 12-5-0



Odell Beckham Jr.  
WR | WFL



<https://sports.yahoo.com/nfl-stars-started-petition-ban-174717471.html>

# Indirect health effects: climate change

- Heat islands
- Flooding
- Petroleum-based
- Greenhouse gas emissions



Extreme heat increases risk of illness and dehydration.



Poor air quality due to increased pollutants and pollen worsen asthma and other breathing and heart problems.



Warmer temperatures promote the growth of bacteria, viruses, and insects.



Extreme weather causes injuries, missed work and school, and mental health issues.



Food supply problems cause malnutrition.



# Tips for Safer Play



Westport, CT

- Post **safety warnings**
- **Avoid** use on **hot days**; measure surface temperature, create a plan
- **Avoid** lounging and **passive activities**
- **Wash hands** before touching face/eating
- **Clean cuts** immediately
- Remove and **shake out gear** and clothes
- Brush hair and **shower** ASAP
- **Monitor** for ingestion
- **Vacuum** any infill that enters your home or car
- **Ventilate** indoor fields



# Be a Smart Consumer

- Consider properly maintained grass fields
- Consider wood mulch or pea gravel on play grounds
- Be aware of Greenwashing
- Look for transparency
  - Composition
  - Hidden costs
  - Maintenance chemicals
- Consider the site
  - Wetlands?
  - Residential?
  - Shade?
  - Environmental Justice community?



## Appropriate Surfacing

- Any material tested to ASTM F1292, including unitary surfaces, engineered wood fiber, etc.
- Pea gravel
- Sand
- Shredded/recycled rubber mulch
- Wood mulch (not CCA-treated)
- Wood chips

<https://www.cpsc.gov/s3fs-public/325.pdf>

# The Partnership for Healthy Playing Surfaces

[Home](#)[Chemicals](#)[Health](#)[Environment](#)[Science](#)[Comparisons](#)

## For Players & Coaches

[Learn more](#) about different playing field surfaces and how they can affect your performance and safety.



## For Parents

The choice of playing field surfaces can have implications for your child's future. [Learn more.](#)



## For Policy Makers

A wide range of health and cost issues should be considered in the choice of playing field surfaces. [Learn more.](#)



## For Medical Professionals

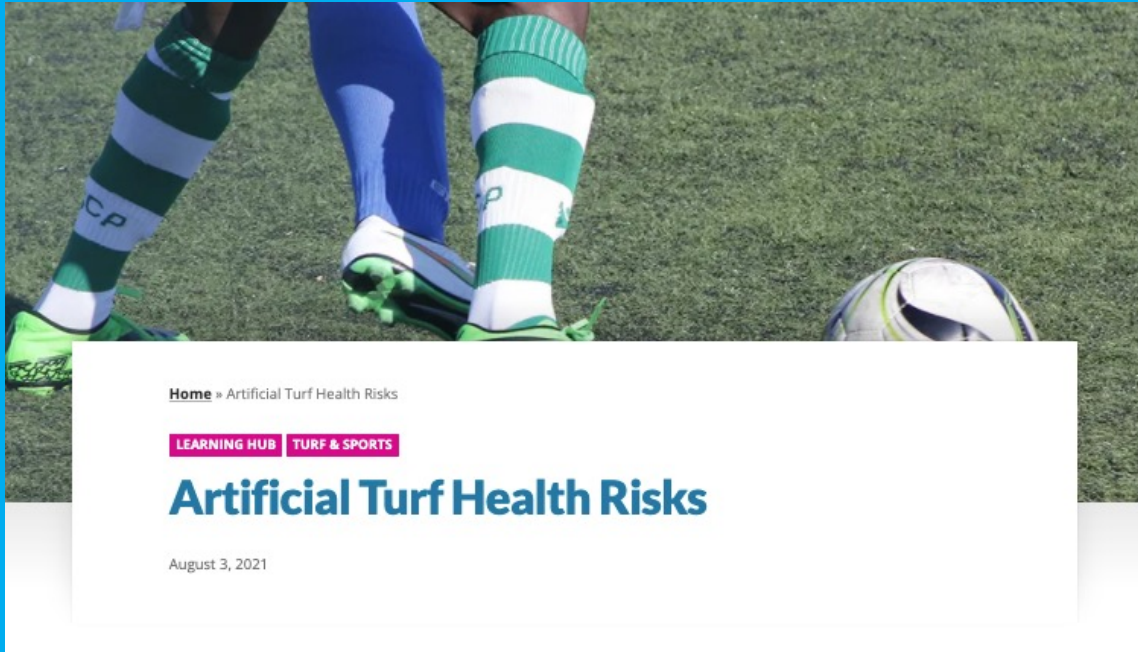
The materials used to construct playing field surfaces can present significant health risks. [Learn more.](#)



<https://www.healthyplayingsurfaces.org/>

# Learn More

<https://sinaisexposomics.org/artificial-turf/>



Many turf products are available or “ecofriendly”, but it can be difficult for children. Read this entry to learn more and understand what the potential health risks may be.



## Position Statement on the use of Recycled Tires in Artificial Turf Surfaces

**Position:** Based upon the presence of known toxic substances in tire rubber and the lack of comprehensive safety studies, The Children’s Environmental Health Center of the Icahn School of Medicine at Mount Sinai urges a moratorium on the use of artificial turf generated from recycled rubber tires.



**Children's Environmental Health Center**  
**Department of Environmental Medicine and Public Health**  
Icahn School of Medicine at Mount Sinai  
One Gustave L. Levy Place, Box 1057  
New York, NY 10029-6574

## **Artificial Turf: A Health-Based Consumer Guide**

If your school, community, or business is considering installing an artificial turf field, it’s important to be an educated consumer. Many turf products are available and some are even advertised as “green” or “eco-friendly”, but it can be difficult to assess their safety for use by children because adequate risk assessment studies that assess all potential routes of exposure during realistic play conditions have not been conducted. This guide will help you dig deeper than the label on the packaging to learn what chemicals these products contain, how children may be exposed to these chemicals, and understand what the potential health risks may be.

### This Guide will:

- 1) Describe turf infill options and chemicals of concern.
- 2) Identify how children can be exposed to these chemicals.

artificial turf products.  
chemicals you want to hear).





@SinaiExposomics

@NYSCHECK  
@R2PEHSU

## BPA and Phthalates

CHILDREN'S ENVIRONMENTAL HEALTH CENTER at the MOUNT SINAI INSTITUTE FOR EXPOSOMIC RESEARCH

Bisphenol A (BPA) and phthalates are chemicals that are added to some plastics.

### Household Chemicals: Keeping Your Family Safe During COVID-19

Proper cleaning, disinfecting, and handwashing are important to prevent transmission of COVID-19. However, chemicals in some products can be harmful to your health. Protect your family from both COVID-19 and chemical exposures by choosing safer products and practices.

### Outdoor Air Pollution

Air pollution refers to harmful gases or particles in the air that come from both natural and man-made sources.

## Artificial Turf

Synthetic or artificial turf is a multi-layer product used as a surface on athletic playing fields, golf courses, and residential lawns.

### It typically consists of:

A top layer of fibers usually made of nylon, polypropylene, or polyethylene designed to mimic natural grass blades; infill that provides cushioning and serves as a base for the blades; a backing layer; a drainage layer; and additional padding in some applications.

### Artificial turf poses a health risk to children through chemical exposures.

Chemicals known to be carcinogenic such as heavy metals, volatile organic compounds (e.g. benzene), polycyclic aromatic hydrocarbons, and 1,3-butadiene have been detected in turf infill made from recycled tires. Further study is needed to characterize the complete chemical composition of infill made from materials other than tires.

#### Exposure can happen through:



Inhalation of chemicals and particles



Dermal contact and absorption through the skin or open wounds



Ingestion of turf infill particles

### Non-chemical exposures of concern to children are...



**Heat:** Turf surface temperatures can get up to 55°F higher than grass, and recorded as high as 200°F on a summer day.



**Turf burn:** Playing on artificial turf has been shown to result in more skin abrasions than grass.

## Glyphosate

Glyphosate is a weed killer, or herbicide. It is the most extensively used pesticide in the world today for both residential and agricultural purposes.

### HOW ARE WE EXPOSED TO GLYPHOSATE?

Glyphosate can be absorbed through the skin, inhaled, or ingested.

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## Pesticides

Pesticides repel or kill unwanted pests such as insects (insecticides), rodents (rodenticides), fungi (fungicides), and weeds (herbicides). All pesticides have the potential to be toxic to humans. Pesticides sold in the United States must be registered with the Environmental Protection Agency (EPA).

### HOW ARE WE EXPOSED TO PESTICIDES?

We can be exposed to pesticides through:

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## Phthalates

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## Flame Retardants

Flame Retardants are chemicals added to a number of products to meet regulatory standards for a product's ability to resist catching on fire. However, mounting evidence demonstrates that many of these chemicals are not effective at preventing fires. Furthermore, recent studies suggest that human health risks associated with flame retardants may outweigh their benefits.

### HOW ARE WE EXPOSED TO FLAME RETARDANTS?

Flame retardant chemicals are released from everyday items that contain them and can then accumulate in house dust. Exposures are increased when foam is damaged or exposed.

Flame retardant chemicals persist in the environment and accumulate in fatty tissues, which means they stay in the body for years. For these same reasons, animals may be exposed to flame retardants in the environment. Eating animal products can also be a source of exposure.

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### WHERE ARE FLAME RETARDANTS FOUND?

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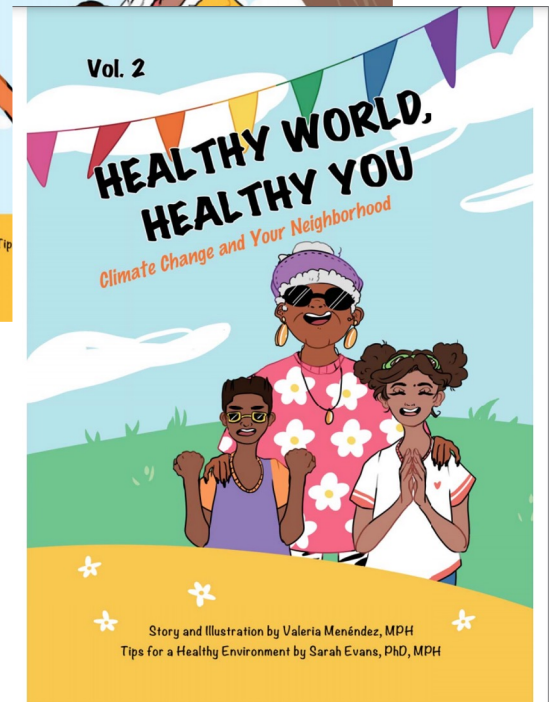
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<https://sinaiexposomics.org/learning-hub/>

<https://icahn.mssm.edu/about/departments/environmental-public-health/cehc/information>

# Acknowledgments



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Health Sciences (EHS) Core Center**  
(P30ES023515)