

# Artificial Turf and Children's Health

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**Mount  
Sinai**

# Acknowledgments



Icahn School  
of Medicine at  
**Mount  
Sinai**

*Institute for  
Exposomic Research*



New York State **Children's**  
Environmental Health Centers

**The Mount Sinai Environmental  
Health Sciences (EHS) Core Center**  
(P30ES023515)

# Overview

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

# Children are not little adults



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GREENPEACE

# 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/>

# Health impacts of turf chemicals

## Carcinogens

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

## Neurotoxicants

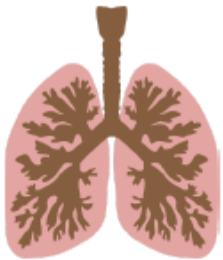
- Lead
- Zinc
- Phthalates
- VOCs

## 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


EPA  
United States  
Environmental Protection  
Agency

EPA/800/R-19/364 | December 2018 | www.epa.gov

ATSDR  
Agency for Toxic Substances  
and Hazardous Waste  
Investigation

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES  
Centers for Disease Control and Prevention

Federal Research Action Plan on  
Recycled Tire Crumb Used on Playing  
Fields and Playgrounds  
STATUS REPORT



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

## 1. Literature Review/Gap Analysis

- 350 chemicals
- No epidemiological studies
- Very few dermal & ingestion studies
- Very few playground studies

## 2. Recycled Tire Crumb Characterization

- Confirmed presence of metals, VOCs, carcinogens
- Toxicity data for half of 355 chemicals
- Not a risk assessment

## 3. Exposure Characterization Study

## 4. Playground Study

# Poured in Place Playground Surfaces

Virgin rubber or plastic,  
urethane, coating &  
colorant

Phthalates  
PAHs  
Lead  
Benzothiazole

Recycled tire rubber (SBR)  
& polyurethane



Sweep regularly, annual inspection, patching, reseal every 1-2 years



# CPSC Playground Surfacing Study

Literature Search/Gaps Analysis



Field Observation



Focus Groups



National Survey



Exposure Modeling

Risk Assessment

## CPSC findings to date:

- ❖ Very few existing studies
- ❖ Children engage in behaviors that increase exposure risk
- ❖ Abrasions are common
- ❖ Maintenance staff prefer loose fill
  - Faster and less expensive to repair
  - Children pick at and vandalize PIP

# Alternative Infills Contain Chemicals of Concern

**Table I.** 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>L1</sup>	Present, lower <sup>L1</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>l</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>L1</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>

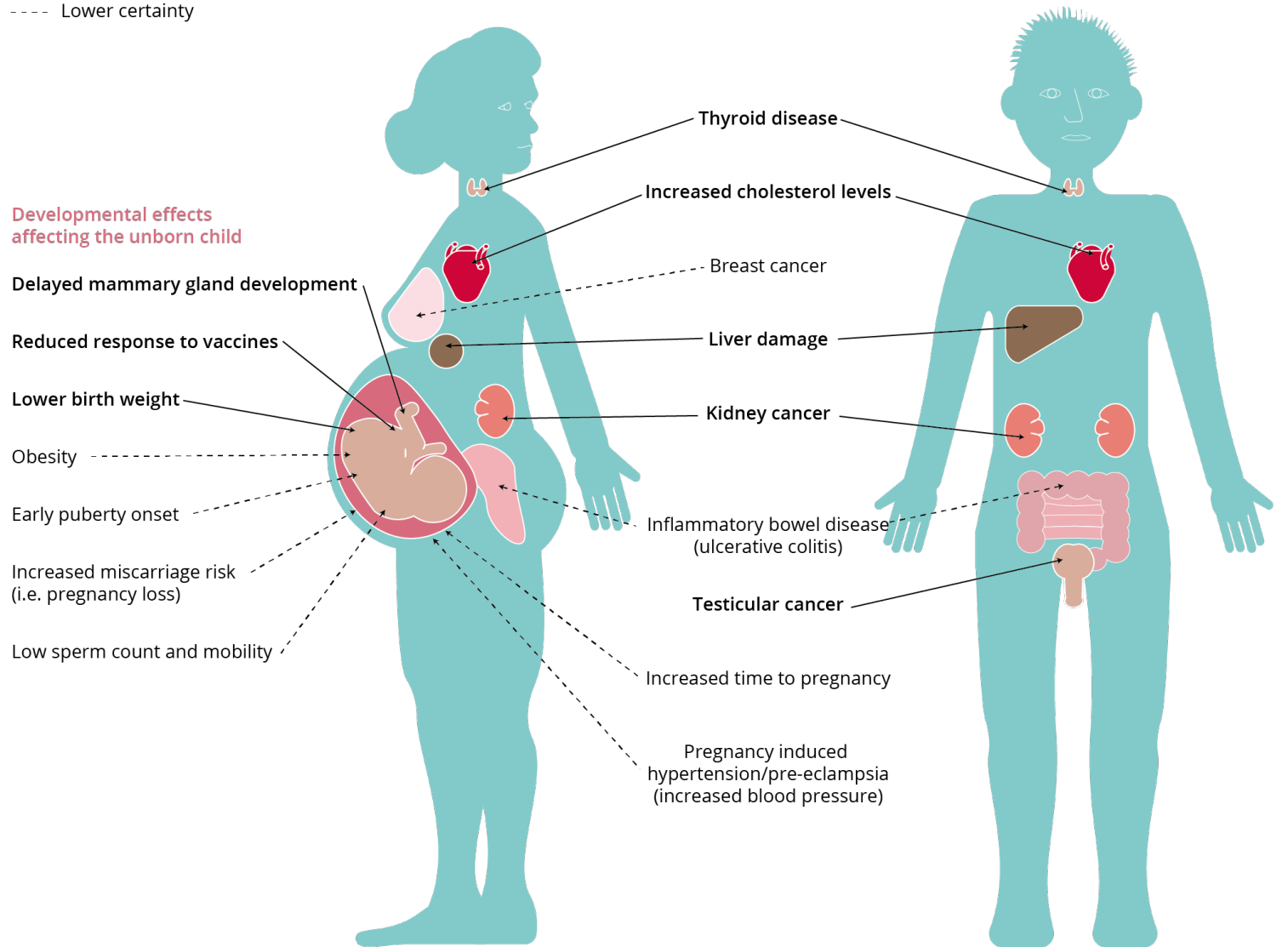
Massey et al. Artificial Turf Infill: A Comparative Assessment of Chemical Contents. *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy*. 2020, Vol. 30(1) 10–26.

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 regulations

## 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*

# Heat effects of turf

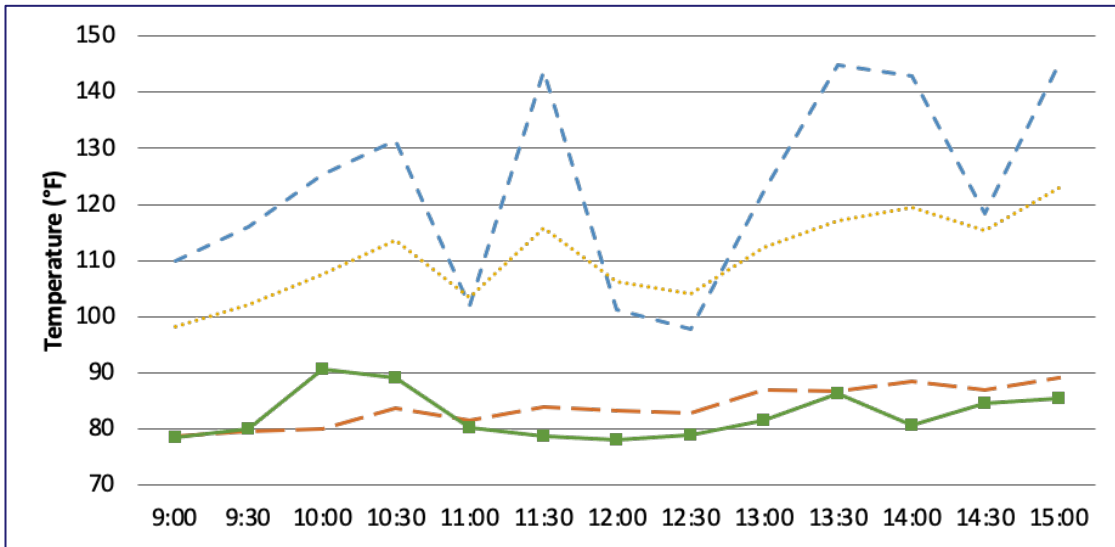


**Thermal effect.** An image taken 14 August 2002 by NASA's Landsat satellite (left) shows surface temperatures in upper Manhattan (red indicates warm temperatures, and blue indicates cool temperatures). A large synthetic turf field created high temperatures similar to those on a large black roof (see 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

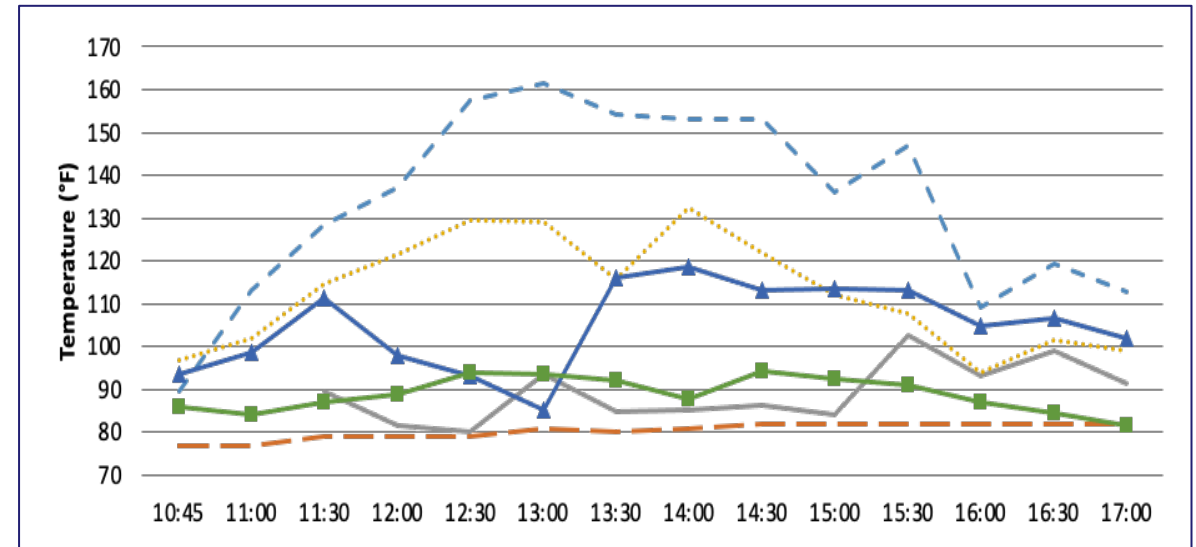
# Dangerous surface temperatures on artificial fields and playgrounds, NYC

## Crumb rubber turf field



--- Rubber surface  
— Sand  
—▲ Wood Mulch

## PIP Playground



--- Ambient Temperature  
... Asphalt  
—■ Grass

Courtesy: Dr. 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
- **Game & practice cancellations/restrictions**
  - No play when surface temp >120°F
  - Precautions and restrictions when air temp >82°F



[https://www.burlingtonpublicschools.org/district/district\\_policies/utilizing\\_artificial\\_turf\\_in\\_the\\_heat](https://www.burlingtonpublicschools.org/district/district_policies/utilizing_artificial_turf_in_the_heat)

# 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:



## Odell Beckham Jr. reacts to Giants WR Sterling Shepard's non-contact injury: 'Why we can't play on grass?'

Shepard suffered a season-ending, non-contact injury during the final moments of Monday's game

By Chris Bengel Sep 28, 2022 at 10:20 am ET · 2 min read



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



# Concussions

## Aging artificial turf fields may carry risk of head injuries

A Charlestown mother sounded the alarm after a popular athletic field repeatedly failed shock absorption tests.

By [Kay Lazar](#) Globe Staff, Updated September 24, 2022, 7:32 p.m.



Johanna Hynes dragged her foot over the artificial turf at Charlestown High School that has repeatedly failed shock absorption tests. JIM DAVIS/GLOBE STAFF

- ❖ 1 in 6 sports concussions due to surface impact
- ❖ NFL: Concussion risk is increased by play on artificial turf and in colder temperatures (Smoliga 2022)
- ❖ Hardness (G-max) should be measured 1-2x per year in multiple field locations and depends greatly on:
  - Proper maintenance
  - Age of field
  - Frequency of play
  - Padding
  - Infill distribution
  - Temperature

# 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

# 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 **engineered wood fiber** or **pea gravel** on playgrounds
- Be aware of **Greenwashing**
- Look for **transparency**
  - Composition
  - Hidden costs
  - Maintenance chemicals
- Consider the **site**
  - Wetlands?
  - Residential?
  - Shade?
  - **Environmental Justice** community?



# 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

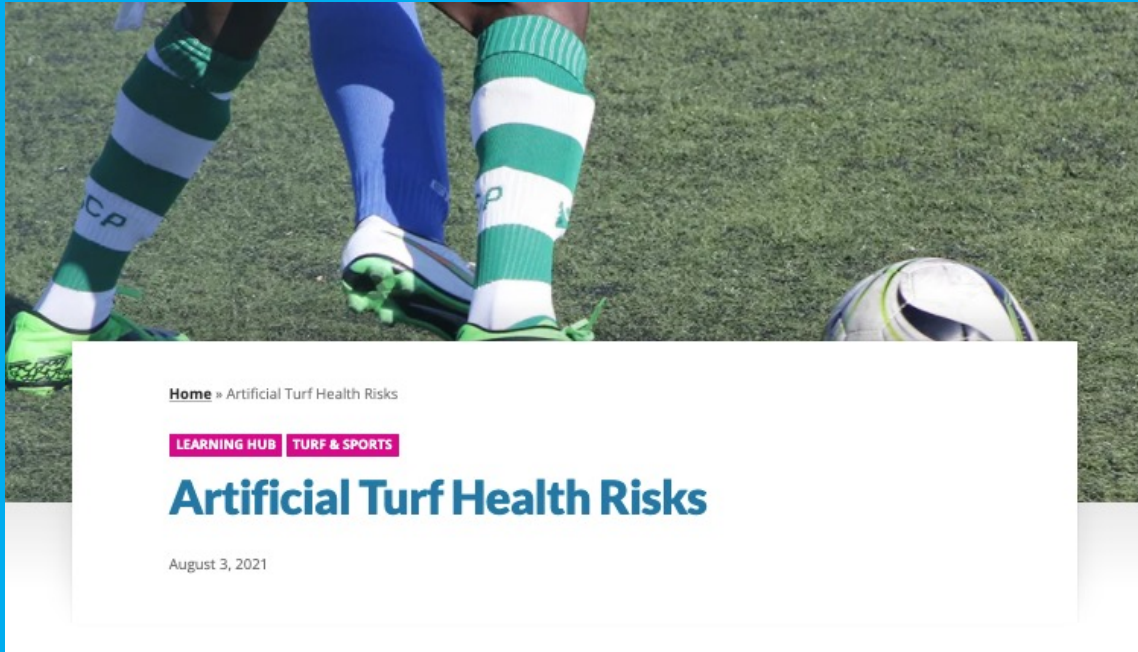
The materials used to construct playing field surfaces can present significant health risks. Learn more.



<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 and understand what the potential



**Mount Sinai** *Children's Environmental Health Center*

## 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.



**Icahn School of Medicine at Mount Sinai** *Children's Environmental Health Center*

**Children's Environmental Health Center  
Department of Environmental Medicine and Public Health**

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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.  
ers you want to hear).