



Digest of Independent Science on  
Public Health Concerns Regarding Synthetic Turf

**INDEX**

- I. Crumb Rubber General
- II. Crumb Rubber Chemicals
  - A. 1,3 Butadiene
  - B. Arsenic
  - C. Arylamines
  - D. Benzene
  - E. Benzothiazoles
  - F. Butylated Hydroxyanisole (BHA)
  - G. Cadmium
  - H. Carbon Black
  - I. Lead
  - J. Manganese
  - K. Mercury
  - L. Phenols
  - M. Phthalates
  - N. Polycyclic Aromatic Hydrocarbons (PAHs)
  - O. Styrene
  - P. Tolidine
  - Q. Trichloroethylene (TCE)
- III. Per- and Polyfluoroalkyl Substances (PFAS)
- IV. Microplastics and Nanoplastics
- V. Bioaccessibility
- VI. Heat Effects
- VII. Injuries
- VIII. Other Health Effects
- IX. Reports & Articles

**I. Crumb Rubber General**

1. Massey, R, Pollard, L, Jacobs, M, Onasch, J, Harari, H, "Artificial turf infill: A comparative assessment of chemical contents," *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy*. (2020) 30(1):10-26.06 <https://pubmed.ncbi.nlm.nih.gov/32089037/>
2. Benoit, G and Demars, S. "Evaluation of organic and inorganic compounds extractable by multiple methods from commercially available crumb rubber mulch." *Water Air and Soil Pollution* (2018) 229:64. <https://link.springer.com/article/10.1007/s11270-018-3711-7>

3. Celeiro, M, Thierry, D, and Llompарт, M. "Determination of priority and other hazardous substances in football fields of synthetic turf by gas chromatography-mass spectrometry: A health and environmental concern." *Chemosphere* (2018) 195: 201-211.  
<https://www.ncbi.nlm.nih.gov/pubmed/29268178>

## II. Crumb Rubber Chemicals

### A. 1,3 Butadiene

1. Grant, RL, et al. "Development of a unit risk factor for 1, 3-butadiene based on an updated carcinogenic toxicity as sessment." *Risk Analysis* (2009) 29:12 1726-1742.  
<https://www.ncbi.nlm.nih.gov/pubmed/19878488>

2. Heck, JE, et al. "Risk of leukemia in relation to exposure to ambient air toxics in pregnancy and early childhood." *International Journal of Hygiene and Environmental Health* (2014) 217:6 662-668.  
<https://www.ncbi.nlm.nih.gov/pubmed/24472648>

3. Koturbash, I, et al. "Epigenetic alterations in liver of C57BL/6J mice after short-term inhalational exposure to 1, 3-butadiene." *Environmental Health Perspectives* (2011) 119:5 635.  
<https://www.ncbi.nlm.nih.gov/pubmed/21147608>

4; Whitworth, KW, Symanski, E, and Coker, AL. "Childhood lymphohematopoietic cancer incidence and hazardous air pollutants in southeast Texas, 1995–2004." *Environmental Health Perspectives* (2008) 116:11 1576. <https://www.ncbi.nlm.nih.gov/pubmed/19057714>

5. Zhou, J, et al. "Health risk assessment of personal inhalation exposure to volatile organic compounds in Tianjin, China." *Science of the Total Environment* (2011) 409:3 452-459.  
<https://www.ncbi.nlm.nih.gov/pubmed/21078521>

### B. Arsenic

1. Chen, Y, et al. "Arsenic exposure at low-to-moderate levels and skin lesions, arsenic metabolism, neurological functions, and biomarkers for respiratory and cardiovascular diseases: review of recent findings from the Health Effects of Arsenic Longitudinal Study (HEALS) in Bangladesh." *Toxicology and Applied Pharmacology* (2009) 239:2, 184-192. <https://www.ncbi.nlm.nih.gov/pubmed/19371619>

2. Kozul, CD, et al. "Low-dose arsenic compromises the immune response to influenza A infection in vivo." *Environmental Health Perspectives* (2009) 117:9, 1441.  
<https://www.ncbi.nlm.nih.gov/pubmed/19750111>

3. Moon, KA, et al. "Association between exposure to low to moderate arsenic levels and incident cardiovascular disease: A prospective cohort study." *Annals of Internal Medicine* (2013) 159:10, 649-659. <https://www.ncbi.nlm.nih.gov/pubmed/24061511>

4. Naujokas, MF, et al. "The broad scope of health effects from chronic arsenic exposure: update on a worldwide public health problem." *Environmental Health Perspectives* (2013) 121:3, 295.  
<https://www.ncbi.nlm.nih.gov/pubmed/23458756>

5. O'Bryant, SE, et al. "Long-term low-level arsenic exposure is associated with poorer neuropsychological functioning: a Project FRONTIER study." *International Journal of Environmental Research and Public* (2011) 8:3, 861-874. <https://www.ncbi.nlm.nih.gov/pubmed/21556183>
6. Parvez, F, et al. "Arsenic exposure and motor function among children in Bangladesh." *Environmental Health Perspectives* (2011) 119:11, 1665. <https://www.ncbi.nlm.nih.gov/pubmed/21742576>
7. Smith, AH, et al. "Increased lung cancer risks are similar whether arsenic is ingested or inhaled." *Journal of Exposure Science and Environmental Epidemiology* (2009) 19:4, 343-348. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2682945/>
8. Tokar, EJ, Diwan, BA, and Waalkes, MP. "Arsenic exposure transforms human epithelial stem/progenitor cells into a cancer stem-like phenotype." *Environmental Health Perspectives* (2010) 118:1, 108. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2831952/>
9. Vahter, M. "Health effects of early life exposure to arsenic." *Basic and Clinical Pharmacology & Toxicology* (2008) 102:2, 204-211. <https://www.ncbi.nlm.nih.gov/pubmed/18226075>
10. Yuan, Y, et al. "Kidney cancer mortality: fifty-year latency patterns related to arsenic exposure." *Epidemiology* (2010) 21:1, 103-108. <https://www.ncbi.nlm.nih.gov/pubmed/20010213>

### **C. Arylamines**

1. Brown, SC, Alberts, R, and Schoenberg, M. "Cancer incidence and mortality among workers exposed to benzidine." *American Journal of Industrial Medicine* (2011) 54:4, 300-306. <https://www.ncbi.nlm.nih.gov/pubmed/21328418>
2. de Vocht, F, et al. "Cancer mortality and occupational exposure to aromatic amines and inhalable aerosols in rubber tire manufacturing in Poland." *Cancer* (2009) 33:2, 94-102. <https://www.ncbi.nlm.nih.gov/pubmed/19679054>
3. English, JC, et al. "Establishing a total allowable concentration of o-toluidine in drinking water incorporating early lifestage exposure and susceptibility." *Regulatory Toxicology and Pharmacology* (2012) 64:2, 269-284. <https://www.ncbi.nlm.nih.gov/pubmed/22940434>
4. Richter, E. "Biomonitoring of human exposure to arylamines." *Frontiers in Bio-Science* (2015) 7: 222-238. <https://www.ncbi.nlm.nih.gov/pubmed/25553373>
5. Tao, L, et al. "Elevated 4-aminobiphenyl and 2, 6-dimethylaniline hemoglobin adducts and increased risk of bladder cancer among lifelong nonsmokers—The Shanghai Bladder Cancer Study." *Cancer Epidemiology and Prevention Biomarkers* (2013) 22:5, 937-945. <https://www.ncbi.nlm.nih.gov/pubmed/23539508>

### **D. Benzene**

1. Andreoli, R, et al. "Urinary biomarkers of exposure and of oxidative damage in children exposed to low airborne concentrations of benzene." *Environmental Research* (2015) 142: 264-272. <https://www.ncbi.nlm.nih.gov/pubmed/26186134>

2. Bahadar, H, Mostafalou, S, and Abdollahi, M. "Current understandings and perspectives on non-cancer health effects of benzene: a global concern." *Toxicology and Applied Pharmacology* (2014) 276:2, 83-94. <https://www.ncbi.nlm.nih.gov/pubmed/24589379>
3. Brosselin, P, et al. "Acute childhood leukaemia and residence next to petrol stations and automotive repair garages: the ESCALE study (SFCE)." *Occupational and Environmental Medicine* (2009) 66:9, 598-606. <https://www.ncbi.nlm.nih.gov/pubmed/19213757>
4. Martins, PC, et al. "Airways changes related to air pollution exposure in wheezing children." *European Respiratory Journal* (2012) 39:2, 246-253. <https://www.ncbi.nlm.nih.gov/pubmed/21719492>
5. McHale, CM, et al. "Global gene expression profiling of a population exposed to a range of benzene levels." *Environmental Health Perspectives* (2011) 119:5, 628. <https://www.ncbi.nlm.nih.gov/pubmed/21147609>
6. Pariselli, F, et al. "Effects of toluene and benzene air mixtures on human lung cells (A549)." *Experimental and Toxicologic Pathology* (2009) 61:4, 381-386. <https://www.ncbi.nlm.nih.gov/pubmed/19046626>
7. Ruchirawat, M, Navasumrit, P, and Settachan, D. "Exposure to benzene in various susceptible populations: co-exposures to 1, 3-butadiene and PAHs and implications for carcinogenic risk." *Chemico-Biological Interactions* (2010) 184:1, 67-76. <https://www.ncbi.nlm.nih.gov/pubmed/20036649>
8. Snyder, R. "Leukemia and benzene." *International Journal of Environmental Research and Public Health* (2012) 9:8, 2875-2893. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3447593/>
9. Xing, C, et al. "Benzene exposure near the US permissible limit is associated with sperm aneuploidy." *Environmental Health Perspectives* (2010) 118:6, 833. <https://www.ncbi.nlm.nih.gov/pubmed/20418200>

#### ***E. Benzothiazoles***

1. Avagyan, R, et al. "Tire tread wear particles in ambient air--a previously unknown source of human exposure to the biocide 2-mercaptobenzothiazole." *Environmental Science and Pollution Research International* (2014) 21:19, 11580-6. <https://www.ncbi.nlm.nih.gov/pubmed/25028318>
2. Li, X, et al. "Characterization of substances released from crumb rubber material used on artificial turf fields." *Chemosphere* (2010) 80:3, 279-285. <https://www.ncbi.nlm.nih.gov/pubmed/20435333>
3. Wan, Y, Xue, J, and Kannan, K. "Benzothiazoles in indoor air from Albany, New York, USA, and its implications for inhalation exposure." *Journal of Hazardous Materials* (2016) 311: 37-42. <https://www.ncbi.nlm.nih.gov/pubmed/26954474>
4. Zhao, B, et al. "Common and consumer products contain activators of the aryl hydrocarbon (dioxin) receptor." *PLoS One* (2013) 8:2. <https://www.ncbi.nlm.nih.gov/pubmed/23441220>

## **F. Butylated Hydroxyanisole (BHA)**

1. Jenerowicz, D, et al. "Environmental factors and allergic diseases." *Annals of Agricultural and Environmental Medicine* (2012) 19:3. <https://www.ncbi.nlm.nih.gov/pubmed/23020042>
2. Kashanian, S, and Dolatabadi, J. "In vitro study of calf thymus DNA interaction with butylated hydroxyanisole." *DNA and Cell Biology* (2009) 28:10, 535-540. <https://www.ncbi.nlm.nih.gov/pubmed/19563252>
3. Pop, A, et al. "Evaluation of the possible endocrine disruptive effect of butylated hydroxyanisole, butylated hydroxytoluene and propyl gallate in immature female rats." *Farmacologia* (2013) 61:1, 202-211. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4462476/>
4. Vandghanooni, S, et al. "Cytotoxicity and DNA fragmentation properties of butylated hydroxyanisole." *DNA and Cell Biology* (2013) 32:3, 98-103. <https://www.ncbi.nlm.nih.gov/pubmed/23413972>

## **G. Cadmium**

1. Adams, SV, Passarelli, MN, and Newcomb, PA, "Cadmium exposure and cancer mortality in the Third National Health and Nutrition Examination Survey cohort." *Occupational Environmental Medicine* (2012) 69:2, 153-156. <https://www.ncbi.nlm.nih.gov/pubmed/22068173>
2. Ferraro, PM, et al. "Low level exposure to cadmium increases the risk of chronic kidney disease: analysis of the NHANES 1999-2006." *BMC Public Health* (2010) 10:1, 304. <https://www.ncbi.nlm.nih.gov/pubmed/20525263>
3. Gallagher, CM, Chen, JJ, and Kovach, JS. "Environmental cadmium and breast cancer risk." *Aging* (Albany, NY) (2010) 2:11, 804. <https://www.ncbi.nlm.nih.gov/pubmed/21071816>
4. García-Esquinas, E, et al. "Cadmium exposure and cancer mortality in a prospective cohort: the strong heart study." *Environmental Health Perspectives* (2014) 122:4, 363. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3984227/pdf/ehp.1306587.pdf>
5. Hossain, MB, et al. "Low-level environmental cadmium exposure is associated with DNA hypomethylation in Argentinean women." *Environmental Health Perspectives* (2012) 120:6, 879. <https://www.ncbi.nlm.nih.gov/pubmed/22382075>
6. Jiang, G, et al. "Effects of long-term low-dose cadmium exposure on genomic DNA methylation in human embryo lung fibroblast cells." *Toxicology*, (2008) 244:1, 49-55. <https://www.ncbi.nlm.nih.gov/pubmed/18077075>
7. Johri, N, Jacquillet, G, and Unwin, R. "Heavy metal poisoning: the effects of cadmium on the kidney." *Biometals* (2010) 23:5, 783-792. <https://www.ncbi.nlm.nih.gov/pubmed/20354761>
8. Kippler, M, et al. "Early-life cadmium exposure and child development in 5-year-old girls and boys: a cohort study in rural Bangladesh." *Environmental Health Perspectives* (2012) 120:10, 1462. <https://www.ncbi.nlm.nih.gov/pubmed/22759600>

9. Nawrot, TS, et al. "Cadmium exposure in the population: from health risks to strategies of prevention." *Biometals* (2010) 23:5, 769-782. <https://www.ncbi.nlm.nih.gov/pubmed/20517707>
10. Peters, JL, et al. "Cadmium exposure in association with history of stroke and heart failure." *Environmental Research* (2010) 110:2, 199-206. <https://www.ncbi.nlm.nih.gov/pubmed/20060521>
11. Rodríguez-Barranco, M, et al. "Cadmium exposure and neuropsychological development in school children in southwestern Spain." *Environmental Research* (2014) 134: 66-73. <https://www.ncbi.nlm.nih.gov/pubmed/25046814>
12. Satarug, S, et al. "Cadmium, environmental exposure, and health outcomes." *Environmental Health Perspectives* (2010) 118: 182-190. <https://www.ncbi.nlm.nih.gov/pubmed/20123617>
13. Tellez-Plaza, M, et al. "Cadmium exposure and all-cause and cardiovascular mortality in the US general population." *Environmental Health Perspectives* (2012) 120:7, 1017. <https://www.ncbi.nlm.nih.gov/pubmed/22472185>

#### **H. Carbon Black**

1. Bourdon, JA, et al. "Carbon black nanoparticle instillation induces sustained inflammation and genotoxicity in mouse lung and liver." *Particle and Fibre Toxicology* (2012) 9:1 <https://www.ncbi.nlm.nih.gov/pubmed/22300514>
2. Bourdon, JA, et al. "Hepatic and pulmonary toxicogenomic profiles in mice intratracheally instilled with carbon black nanoparticles reveal pulmonary inflammation, acute phase response, and alterations in lipid homeostasis." *Toxicological Sciences* (2012) 127:2, 474-484. <https://www.ncbi.nlm.nih.gov/pubmed/22461453>
3. Hussain, S, et al. "Carbon black and titanium dioxide nanoparticles elicit distinct apoptotic pathways in bronchial epithelial cells." *Particle and Fibre Toxicology* (2010) 7:1 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2873464/>
4. Jacobsen, NR, et al. "Mutation spectrum in FE1-MUTA(TM) Mouse lung epithelial cells exposed to nanoparticulate carbon black." *Environmental and Molecular Mutagens* (2011) 52:4, 331-337. <https://www.ncbi.nlm.nih.gov/pubmed/20963790>
5. Neghab, M, Mohraz, MH, and Hassanzadeh, J. "Symptoms of respiratory disease and lung functional impairment associated with occupational inhalation exposure to carbon black dust." *Journal of Occupational Health* (2011) 53:6, 432-438. <https://www.ncbi.nlm.nih.gov/pubmed/21996929>
6. Reisetter, AC, et al. "Induction of inflammasome-dependent pyroptosis by carbon black nanoparticles." *Journal of Biological Chemistry* (2011) 286:24, 21844-21852. <https://www.ncbi.nlm.nih.gov/pubmed/21525001>
7. Saputra, D, et al. "Inhalation of carbon black nanoparticles aggravates pulmonary inflammation in mice." *Toxicological Research* (2014) 30:2, 83. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4112069/>

8. Vesterdal, LK, et al. "Carbon black nanoparticles and vascular dysfunction in cultured endothelial cells and artery segments." *Toxicology Letters* (2012) 214:1, 19-26. <https://www.ncbi.nlm.nih.gov/pubmed/22885096>
9. Zhang, R, et al. "Reduced pulmonary function and increased pro-inflammatory cytokines in nanoscale carbon black-exposed workers." *Particle and Fibre Toxicology* (2014) 11:1, 73. <https://www.ncbi.nlm.nih.gov/pubmed/25497989>

### **I. Lead**

1. Betts, KS. "CDC updates guidelines for children's lead exposure." *Environmental Health Perspectives* (2012) 120:7. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3404672/pdf/ehp.120-a268.pdf>
2. Dapul, H and Laraque, D. "Lead poisoning in children." *Advances in Pediatrics* (2014) 61: 313-333. <https://www.ncbi.nlm.nih.gov/pubmed/25037135>
3. Evens, A, et al. "The impact of low-level lead toxicity on school performance among children in the Chicago Public Schools: a population-based retrospective cohort study." *Environmental Health* (2015) 14. <https://www.ncbi.nlm.nih.gov/pubmed/25889033>
4. Grandjean, P and Landrigan, P. "Neurobehavioural effects of developmental toxicity." *The Lancet Neurology* (2014) 13:3, 330-338. <https://www.ncbi.nlm.nih.gov/pubmed/24556010>
5. Jakubowski, M. "Low-level environmental lead exposure and intellectual impairment in children – the current concepts of risk assessment." *International Journal of Occupational Medicine and Environmental Health* (2011) 24:1, 1-7. <https://www.ncbi.nlm.nih.gov/pubmed/21468897>
6. Jusko, TA, et al. "Blood lead concentrations < 10 µg/dL and child intelligence at 6 years of age." *Environmental Health Perspectives* (2008) 116:2, 243-248. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2235210/>
7. Levin, R, et al. "Lead exposures in U.S. children, 2008: implications for prevention." *Environmental Health Perspectives* (2008) 116:10, 1285–1293. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2569084/>
8. Mason, LH, et al. "Pb neurotoxicity: neuropsychological effects of lead toxicity." *Biomed Research International* (2014). <https://www.ncbi.nlm.nih.gov/pubmed/24516855>
9. Van Ulirsch, G, et al. "Evaluating and regulating lead in synthetic turf." *Environmental Health Perspectives* (2010) 118:10, 1345–1349. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2957910/>

### **J. Manganese**

1. Burton NC and TR Guilarte. "Manganese neurotoxicity: Lessons learned from longitudinal studies in nonhuman primates." *Environmental Health Perspectives* (2009) 117:3, 325-332. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2661898/>

2. Guilarte, TR. “Manganese neurotoxicity: new perspectives from behavioral, neuroimaging, and neuropathological studies in humans and non-human primates.” *Frontiers in Aging Neuroscience* (2013) 5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3690350/>
3. Karki, P, et al. “Manganese neurotoxicity: a focus on glutamate transporters.” *Annals of Occupational and Environmental Medicine* (2013) 25. <https://www.ncbi.nlm.nih.gov/pubmed/24472696>
4. Neala, A and TR Guilarte. “Mechanisms of lead and manganese neurotoxicity.” *Toxicology Research* (2013) 2:2, 99–114. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4338437/>

### **K. Mercury**

1. Bernhoft, RA. “Mercury toxicity and treatment: A review of the literature.” *Journal of Environmental and Public Health* (2012). <https://www.ncbi.nlm.nih.gov/pubmed/22235210>
2. Bose-O’Reilly, S, et al. “Mercury exposure and children's health.” *Current Problems in Pediatric and Adolescent Health Care* (2010) 40:8, 186-215. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096006/>
3. Boujbiha, MA, et al. “Testicular toxicity in mercuric chloride treated rats: association with oxidative stress.” *Reproductive Toxicology* (2009) 28:1, 81-89. <https://www.ncbi.nlm.nih.gov/pubmed/19427169>
4. Crespo-Lopez, ME, et al. “Mercury and human genotoxicity: critical considerations and possible molecular mechanisms.” *Pharmacological Research* (2009) 60:4, 212-220. <https://www.ncbi.nlm.nih.gov/pubmed/19446469>
5. Holmes, P, et al. “Is low-level environmental mercury exposure of concern to human health?” *Science of The Total Environment* (2009) 408:2, 171-182. <https://www.ncbi.nlm.nih.gov/pubmed/19850321>
6. Park, J and Zheng, W. “Human exposure and health effects of inorganic and elemental mercury.” *Journal of Preventive Medicine & Public Health* (2012) 45:6, 344–352. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3514464/>
7. Rice, KM, et al. “Environmental mercury and its toxic effects.” *Journal of Preventive Medicine & Public Health* (2014) 47:2, 74-83. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3988285/>

### **L. Phenols**

1. Barlas, N and Aydoğan, M. “Histopathologic effects of maternal 4-tert-octylphenol exposure on liver, kidney and spleen of rats at adulthood.” *Archives of Toxicology* (2009) 83:4, 341-349. <https://www.ncbi.nlm.nih.gov/pubmed/18754100>
2. Calafat, AM, et al. “Exposure of the U.S. population to bisphenol A and 4-tertiary-octylphenol: 2003–2004.” *Environmental Health Perspectives* (2008) 116:1, 39-44. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2199288/>



3. Sainath, SB, et al. "Embryonic exposure to octylphenol induces changes in testosterone levels and disrupts reproductive efficiency in rats at their adulthood." *Food and Chemical Toxicology* (2011) 49:4, 983-990. <https://www.ncbi.nlm.nih.gov/pubmed/21219960>
4. Ulutas, OK, et al. "An in vivo assessment of the genotoxic potential of bisphenol A and 4-tertiary-octylphenol in rats." *Archives of Toxicology* (2011) 85: 995-1001. <https://www.ncbi.nlm.nih.gov/pubmed/21113705>
5. Yildiz, N. and Barlas, N. "Hepatic and renal functions in growing male rats after bisphenol A and octylphenol exposure." *Human and Experimental Technology* (2013) 32:7, 675-686. <https://www.ncbi.nlm.nih.gov/pubmed/23821587>

### **M. Phthalates**

1. Boas, Malene, et al. "Childhood exposure to phthalates: associations with thyroid function, insulin-like growth factor I, and growth." *Environmental Health Perspectives* (2010) 118:10. <https://www.ncbi.nlm.nih.gov/pubmed/20621847>
2. Bornehag, CG, and Nanberg, E. "Phthalate exposure and asthma in children." *International Journal of Andrology* (2010) 33:2, 333-345. <https://www.ncbi.nlm.nih.gov/pubmed/20059582>
3. Cho, S, et al. "Relationship between environmental phthalate exposure and the intelligence of school-age children." *Environmental Health Perspectives* (2010) 118:7, 1027. <https://www.ncbi.nlm.nih.gov/pubmed/20194078>
4. Chopra, V, et al. "Association between phthalates and attention deficit disorder and learning disability in US children, 6–15 years." *Environmental Research* (2014) 128, 64-69. <https://www.ncbi.nlm.nih.gov/pubmed/24267794>
5. Chou, Y, et al. "Phthalate exposure in girls during early puberty." *International Journal of Andrology* (2009) 22:1, 69-78. <https://www.ncbi.nlm.nih.gov/pubmed/19344077>
6. Kim, B, et al. "Phthalates exposure and attention-deficit/hyperactivity disorder in school-age children." *Biological Psychiatry* (2009) 66:10, 958-963 <https://www.ncbi.nlm.nih.gov/pubmed/19748073>
7. Koch, HM, et al. "Exposure to phthalates in 5–6 years old primary school starters in Germany—a human biomonitoring study and a cumulative risk assessment." *International Journal of Hygiene and Environmental Health* (2011) 214:3, 188-195. <https://www.ncbi.nlm.nih.gov/pubmed/21371937>

### **N. Polycyclic Aromatic Hydrocarbons (PAHs)**

1. Bae, S, et al. "Exposures to particulate matter and polycyclic aromatic hydrocarbons and oxidative stress in schoolchildren." *Environmental Health Perspectives* (2010) 118:4, 579. <https://www.ncbi.nlm.nih.gov/pubmed/20368125>
2. Edwards, SC, et al. "Prenatal exposure to airborne polycyclic aromatic hydrocarbons and children's intelligence at 5 years of age in a prospective cohort study in Poland." *Environmental Health Perspectives* (2010) 118:9. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2944097/>

3. Grant, WB. "Air pollution in relation to US cancer mortality rates: an ecological study; likely role of carbonaceous aerosols and polycyclic aromatic hydrocarbons." *Anticancer Research* (2009) 29:9, 3537-3545. <https://www.ncbi.nlm.nih.gov/pubmed/19667146>
4. Jung, KH, et al. "Assessment of benzo (a) pyrene-equivalent carcinogenicity and mutagenicity of residential indoor versus outdoor polycyclic aromatic hydrocarbons exposing young children in New York City." *International Journal of Environmental Research and Public Health* (2010) 7:5, 1889-1900. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2898023/>
5. Kim, K, et al. "A review of airborne polycyclic aromatic hydrocarbons (PAHs) and their human health effects." *Environment International* (2013) 60: 71-80. <https://www.ncbi.nlm.nih.gov/pubmed/24013021>
6. Perera, FP, et al. "Polycyclic aromatic hydrocarbons–aromatic DNA adducts in cord blood and behavior scores in New York City children." *Environmental Health Perspectives* (2011) 119:8, 1176. <https://www.ncbi.nlm.nih.gov/pubmed/21486719>

### **O. Styrene**

1. Harvilchuck, JA, et al. "Indicators of oxidative stress and apoptosis in mouse whole lung and Clara cells following exposure to styrene and its metabolites." *Toxicology* (2009) 264:3 171-178. <https://www.ncbi.nlm.nih.gov/pubmed/19666080>
2. Huff, J, and Infante, PF. "Styrene exposure and risk of cancer." *Mutagenesis* (2011) 26:5, 583-584. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3165940/>
3. Mögel, I, et al. "The aromatic volatile organic compounds toluene, benzene and styrene induce COX-2 and prostaglandins in human lung epithelial cells via oxidative stress and p38 MAPK activation." *Toxicology* (2011) 289:1, 28-37. <https://www.ncbi.nlm.nih.gov/pubmed/21801798>
4. Roder-Stolinkis, C, et al. "Styrene induces an inflammatory response in human lung epithelial cells via oxidative stress and NF-κB activation." *Toxicology and Applied Pharmacology* (2008) 231:2, 241-247. <https://www.ncbi.nlm.nih.gov/pubmed/18554678>
5. Rueff, J, et al. "Genetic effects and biotoxicity monitoring of occupational styrene exposure." *Clinica Chimica Acta* (2009) 399.1, 8-23. <https://www.ncbi.nlm.nih.gov/pubmed/18845133>
6. Sati, PC. "Pulmonary function and oxidative stress in workers exposed to styrene in plastic factory: Occupational hazards in styrene-exposed plastic factory workers." *Human and Experimental Toxicology* (2011) 30:11, 1743-1750. <https://www.ncbi.nlm.nih.gov/pubmed/21382913>
7. Wongvijitsuk, S, et al. "Low level occupational exposure to styrene: its effects on DNA damage and DNA repair." *International Journal of Hygiene and Environmental Health* (2011) 214.2, 127-137. <https://www.ncbi.nlm.nih.gov/pubmed/21030303>

### **P. Toluidine**

1. Böhm, F, et al. "DNA adducts of ortho-toluidine in human bladder." *Biomarkers* (2011) 16:2, 120-128. <https://www.ncbi.nlm.nih.gov/pubmed/21117897>
2. Carreón, T, et al. "Bladder cancer incidence among workers exposed to o-toluidine, aniline and nitrobenzene at a rubber chemical manufacturing plant." *Occupational Environmental Medicine* (2013). <https://www.ncbi.nlm.nih.gov/pubmed/24368697>
3. Sorahan, Tom. "Bladder cancer risks in workers manufacturing chemicals for the rubber industry." *Occupational Medicine* (2008) 58:7, 496-501. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1757501/>

### ***Q. Trichloroethylene***

1. Blossom, SJ, et al. "Developmental exposure to trichloroethylene promotes CD4+ T cell differentiation and hyperactivity in association with oxidative stress and neurobehavioral deficits in MRL+/+ mice." *Toxicology and Applied Pharmacology* (2008) 231:3, 344-353. <https://www.ncbi.nlm.nih.gov/pubmed/18579175>
2. Blossom, SJ, et al. "Metabolic changes and DNA hypomethylation in cerebellum are associated with behavioral alterations in mice exposed to trichloroethylene postnatally." *Toxicology and Applied Pharmacology* (2013) 269:3, 263-269. <https://www.ncbi.nlm.nih.gov/pubmed/23566951>
3. Cai, P, et al. "Chronic exposure to trichloroethene causes early onset of SLE-like disease in female MRL+/+ mice." *Toxicology and Applied Pharmacology* (2008) 228:1, 68-75. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2442272/>
4. Chiu, WA, et al. "Human health effects of trichloroethylene: key findings and scientific issues." *Environmental Health Perspectives* (2013) 121:3, 303. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3621199/>
5. Cooper, GS, et al. "Evidence of autoimmune-related effects of trichloroethylene exposure from studies in mice and humans." *Environmental Health Perspectives* (2009) 117:5, 696. <https://www.ncbi.nlm.nih.gov/pubmed/19479009>
6. Hu, C, et al. "Possible involvement of oxidative stress in trichloroethylene-induced genotoxicity in human HepG2 cells." *Mutation Research/Genetic Toxicology and Environmental Mutagenesis* (2008) 29:1, 88-94. <https://www.ncbi.nlm.nih.gov/pubmed/18289923>
7. Jiang, Y, et al. "Trichloroethylene-induced gene expression and DNA methylation changes in B6C3F1 mouse liver." *PLoS ONE* (2014) 9:12. <https://www.ncbi.nlm.nih.gov/pubmed/25549359>
8. Karami, S, et al. "Occupational trichloroethylene exposure and risk of lymphatic and haematopoietic cancers: a meta-analysis." *Occupational and Environmental Medicine* (2013) 70: 591-599. <https://www.ncbi.nlm.nih.gov/pubmed/23723297>
9. Khan, S, et al. "Effect of trichloroethylene (TCE) toxicity on the enzymes of carbohydrate metabolism, brush border membrane and oxidative stress in kidney and other rat tissues." *Food and Chemical Toxicology* (2009) 47:7, 1562-1568. <https://www.ncbi.nlm.nih.gov/pubmed/19361549>

10. Lan, Q, et al. "Occupational exposure to trichloroethylene is associated with a decline in lymphocyte subsets and soluble CD27 and CD30 markers." *Carcinogenesis* (2010) 31:9, 1592–1596. <https://www.ncbi.nlm.nih.gov/pubmed/20530238>
11. Lash, LH, et al. "Trichloroethylene biotransformation and its role in mutagenicity, carcinogenicity and target organ toxicity." *Mutation Research/Reviews in Mutation Research* (2014) 762, 22–36. <https://www.ncbi.nlm.nih.gov/pubmed/25484616>
12. Purdue, MP, et al. "A case–control study of occupational exposure to trichloroethylene and non-Hodgkin lymphoma." *Environmental Health Perspectives* (2011) 119:2, 232. <https://www.ncbi.nlm.nih.gov/pubmed/21370516>
13. Rusyn, I, et al. "Trichloroethylene: Mechanistic, epidemiologic and other supporting evidence of carcinogenic hazard." *Pharmacology & Therapeutics* (2014) 141:1, 55-68. <https://www.ncbi.nlm.nih.gov/pubmed/23973663>
14. Siegel Scott, C, and Jinot, J. "Trichloroethylene and cancer: systematic and quantitative review of epidemiologic evidence for identifying hazards." *International Journal of Environmental Research and Public Health* (2011) 8:11, 4238-4271. <https://www.ncbi.nlm.nih.gov/pubmed/22163205>

### III. Per- and Polyfluoroalkyl Substances (PFAS)

2. Dragon, J, Hoaglund, M, Baderreddy, A, et al. "Perfluoroalkyl substances (PFAS) affect inflammation in lung cells and tissues." *International Journal of Molecular Sciences* (2023) 24:10, 8539 <https://doi.org/10.3390/ijms24108539>
3. Anderko, L, Pennea, E. "Exposures to per- and polyfluoroalkyl substances (PFAS): Protective risks to reproductive and children's health." *Current Problems in Pediatric and Adolescent Health Care* (2020) Vol 50, Issue 2 <https://doi.org/10.1016/j.cppeds.2020.100760>
4. Murphy, M, and Warner, G. "Health impacts of artificial turf: Toxicity studies, challenges, and future directions." *Environmental Pollution* (2022) Vol. 310: 119841 <https://pubmed.ncbi.nlm.nih.gov/35948114/>
5. Ankley, G, Cureton, P, Hoke, R, et al. "Assessing the ecological risks of per- and polyfluoroalkyl substances: Current state-of-the-science and a proposed path forward." *Environmental Toxicology and Chemistry* (2020) 564-605 <https://doi.org/10.1002/etc.4869>
6. Zuccaro, P, et al. "Assessing extraction-analysis methodology to detect fluorotelomer alcohols (FTOH), a class of perfluoroalkyl and polyfluoroalkyl substances (PFAS), in artificial turf fibers and crumb rubber infill." *Case Studies in Chemical and Environmental Engineering* (2023) Vol. 7, 100280. <https://doi.org/10.1016/j.cscee.2022.100280>
7. Espartero, Y, et al. "Health related toxicity of emerging per- and polyfluoroalkyl substances: Comparisons to legacy PFOS and PFOA." *Environmental Research* (2022) Vol. 212, Part C, 113431 <https://www.sciencedirect.com/science/article/abs/pii/S0013935122007587>
8. Stanifer, JW, et al. "Perfluorinated chemicals as emerging environmental threats to kidney health." *Clinical Journal of the American Society of Nephrology* (2018) 13:10 1479–1492.

<https://doi.org/10.2215/cjn.04670418>

9. Lauris, M, et al. "Widespread occurrence of non-extractable fluorine in artificial turfs from Stockholm, Sweden" *Environmental Science Technology Letters* (2022) 9, 8, 666-672  
<https://pubs.acs.org/doi/10.1021/acs.estlett.2c00260>

10. Fenton, SE, et al. "Per- and polyfluoroalkyl substance toxicity and human health review: Current state of knowledge and strategies for informing future research." *Environmental Toxicology and Chemistry* (2020) 40:3,606–630. <https://doi.org/10.1002/etc.4890>

11. Dhore, R, and Murthy, G. "Per/polyfluoroalkyl substances production, applications and environmental impacts." *Bioresource Technology* (2021) Vol. 341:125808  
<https://pubmed.ncbi.nlm.nih.gov/34455249/>

12. Ragnarsdottir, O., et al, "Dermal uptake: An important pathway of human exposure to perfluoroalkyl substances?" *Environmental Pollution*, August 2022, Vol. 307  
<https://www.sciencedirect.com/science/article/pii/S0269749122006923>

#### **IV. Microplastics and Nanoplastics**

1. de Haan, et al. "The dark side of artificial greening: Plastic turfs as widespread pollutants of aquatic environments." *Environmental Pollution* (2023) Oct 1;334:122094.  
<https://pubmed.ncbi.nlm.nih.gov/37392868/>

2. Landrigan, PJ, et al. "The Impact of Plastics on Human Health." *Annals of Global Health*, The Minderoo-Monaco Commission on Plastics and Human Health (2023) 89:1

23. <https://pubmed.ncbi.nlm.nih.gov/36969097/>

3. Saha, SC, et al. "Effect of microplastics deposition on human lung airways: A review with computational benefits and challenges." *Helion* (2024)  
10:2. <https://pubmed.ncbi.nlm.nih.gov/38293398/#:~:text=Research%20has%20indicated%20that%20microplastics,where%20gas%20exchange%20takes%20place>

4. Abafe O, Harrad S, Abdallah M, "Assessment of human dermal absorption of flame retardant additives in polyethylene and polypropylene microplastics using 3D human skin equivalent models" *Environment International*, April 2024, Volume 186, 108635  
<https://www.sciencedirect.com/science/article/pii/S0160412024002216?via%3Dihub>

5. Trasande L, Krithivasan R, et al, "Chemicals used in plastic materials: An estimate of the attributable disease burden and costs in the United States" *Journal of the Endocrine Society*, Jan 2024 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10783259/>

6. Zhong Y, Yang Y, et al, "Revealing new insights: Two-center evidence of microplastics in human vitreous humor and their implications for ocular health" *Science of the Total Environment*, April 2024, Volume 921  
<https://www.sciencedirect.com/science/article/abs/pii/S0048969724012488>

7. Kim H, Ashim J et al, "A preliminary study about the potential risks of the UV-weathered microplastic: The proteome-level changes in the brain in response to polystyrene derived weathered microplastics" *Environmental Research*, Sept 2023, Vol 233  
<https://www.sciencedirect.com/science/article/abs/pii/S001393512301215X?via%3Dihub>
8. Lee JY, Chia R, et al, "A comprehensive review of urban microplastic pollution sources, environment and human health impacts, and regulatory efforts" *Science of the Total Environment*, June 2024, Volume 946  
<https://www.sciencedirect.com/science/article/abs/pii/S0048969724044450?via%3Dihub>
9. Takahashi K, Fujinuma R, et al, "Migration of artificial turf fibers from artificial turf sports field and their ingestion by goldfish" *Environments* 2023, 10 (12), 222;  
<https://doi.org/10.3390/environments10120222>
10. Various authors, "The trouble with plastics" *Birth Defects Research*, Oct 2020, Volume 112, Issue 17 <https://onlinelibrary.wiley.com/toc/24721727/2020/112/17>

## V. Bioaccessibility

1. Marsili L, et al. "Release of polycyclic aromatic hydrocarbons and heavy metals from rubber crumb in synthetic turf fields: Preliminary hazard assessment for athletes." *Environment & Analytical Toxicology* (2014) Vol. 5:2  
<https://www.hilarispublisher.com/open-access/release-of-polycyclic-aromatic-hydrocarbons-and-heavy-metals-from-rubber-crumb-in-synthetic-turf-fields-2161-0525.1000265.pdf>
2. Kim, S, et al. "Health risk assessment of lead ingestion exposure by particle sizes in crumb rubber on artificial turf considering bioavailability." *Environmental Health and Toxicology* (2012) Vol. 27  
<https://pubmed.ncbi.nlm.nih.gov/22355803/>
3. Zhang, J, et al. "Hazardous chemicals in synthetic turf materials and their bioaccessibility in digestive fluids." *Journal of Exposure Science & Environmental Epidemiology* (2008) 18:6  
<https://www.nature.com/articles/jes200855>
4. Pavilonis, B, et al. "Bioaccessibility and risk of exposure to metals and SVOCs in artificial turf field Fill Materials and Fiber." *Society of Risk Analysis* (2014) 34:1  
<https://onlinelibrary.wiley.com/doi/10.1111/risa.12081>

## VI. Heat Effects

1. Thoms, A, et al. "Models for predicting surface temperatures on synthetic playing surfaces." *Procedia Engineering* (2014) 72: 895-900.  
<http://www.sciencedirect.com/science/article/pii/S1877705814006699>
2. Pryor, J, et al. "The heat strain of various athletic surfaces: A comparison between observed and modeled wet-bulb globe temperatures." *Journal of Athletic Training* (2017) 52:11 1056-1064  
<https://pubmed.ncbi.nlm.nih.gov/29095037/>

3. Abraham, J, "Heat risks associated with synthetic athletic fields." *International Journal of Hyperthermia: the Official Journal of European Society for Hyperthermic Oncology, North American Hyperthermia Group* (2019) Vol. 36:1  
<https://www.tandfonline.com/doi/full/10.1080/02656736.2019.1605096>
4. American Academy of Pediatrics: Council on sports medicine and fitness and council on school health. "Policy Statement – Climatic heat stress and exercising children and adolescents." *Pediatrics* (2011) 128:3 741-747.  
<http://pediatrics.aappublications.org/content/128/3/e741>
5. Penn State's Center for Sports Surface Research. "Synthetic turf heat evaluation – progress report." (2012)  
<http://plantscience.psu.edu/research/centers/ssrc/documents/heat-progress-report.pdf>
6. Bristol, S, Mac Dermott, V, "Thermal effects associated with crumb rubber in-filled synthetic turf athletic fields." *Evaluation of the Environmental Effects of Synthetic Turf Athletic Fields* (2008) 6-23  
[https://cdn.ymaws.com/syntheticurf council.site-ym.com/resource/resmgr/docs/milone\\_macbroom-leaching\\_of.pdf](https://cdn.ymaws.com/syntheticurf council.site-ym.com/resource/resmgr/docs/milone_macbroom-leaching_of.pdf)
7. McNitt, AS, et al. "Temperature amelioration of synthetic turf surfaces through irrigation." *Pennsylvania State University, Acta Horticulturae* (2008) 783: 573-582.  
<http://plantscience.psu.edu/research/centers/ssrc/documents/temperature-irrigation.pdf>

## **VII. Injuries**

1. Drakos, M, et al. "Synthetic playing surfaces and athlete health." *Journal of the American Academy of Orthopedic Surgeons* (2013) 21:5: 293-302.  
<https://www.ncbi.nlm.nih.gov/pubmed/23637148>
2. Fujitaka, K, et al. "Effect of changes in artificial turf on sports injuries in male university soccer players." *The Orthopedic Journal of Sports Medicine* (2017) 5:8  
<https://www.ncbi.nlm.nih.gov/pubmed/28812040>
3. Akkaya, S, et al. "Football injuries on synthetic turf fields." *Joint Diseases and Related Surgery* (2011) 22:3 155-159. <https://www.ncbi.nlm.nih.gov/pubmed/22085351>
4. Stiles, VH, et al. "Natural turf surfaces: The case for continued research" *Sports Medicine* (2009) 39:1 65-84  
<https://www.ncbi.nlm.nih.gov/pubmed/19093696>
5. Balazs, GC, et al. "Risk of anterior cruciate ligament injury in athletes on synthetic playing surfaces: A systematic review." *American Journal of Sports Medicine* (2014) 43:7 1798-1804.  
<https://www.ncbi.nlm.nih.gov/pubmed/25164575>
6. Aoki, H, et al. "Incidence of injury among adolescent soccer players: a comparative study of artificial and natural grass turfs." *Clinical Journal of Sport Medicine* (2010) 20:1.  
<https://www.ncbi.nlm.nih.gov/pubmed/20051727>

7. George, E, et al. "Incidence and risk factors for turf toe injuries in intercollegiate football: data from the national collegiate athletic association injury surveillance system." *Foot & Ankle International* (2014) 35:2 108-115.  
<https://www.ncbi.nlm.nih.gov/pubmed/24334272>
8. Poulos, C, et al. "The perceptions of professional soccer players on the risk and injury from competition and training on natural turf grass and 3<sup>rd</sup> generation artificial turf." *BMC Sports Science, Medicine and Rehabilitation* (2014) 6:11 <https://www.ncbi.nlm.nih.gov/pubmed/24581229>
9. van den Eijnde, WA, et al. "Understanding the acute skin injury mechanism caused by player-surface contact during soccer: A survey and systemic review." *The Orthopedic Journal of Sports* (2014) 2:5  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4555542/>
10. Lanzetti, RM, et al. "The influence of playing surface on injury risk in Italian elite rugby players." *Muscles, Ligaments and Tendons Journal* (2017) 7:1 180-185.  
<https://www.ncbi.nlm.nih.gov/pubmed/28717627>
11. Dragoo, JL, Braun, HJ, "The effects of playing surface on injury rate: a review of the current literature." *Sports* (2010) 40:11 981-990.  
<https://www.ncbi.nlm.nih.gov/pubmed/20942512>
12. Taylor, SA, et al. "A review of synthetic playing surfaces, the shoe-surface interface, and lower extremity injuries in athletes." *The Physician and Sports Medicine*. (2012) 40:4, 66-72  
<https://www.tandfonline.com/doi/abs/10.3810/psm.2012.11.1989>
13. Wright, JM and Webner, D, "Playing field issues in sports medicine." *Current Sports Medicine Reports* (2010) 9:3 129-133.  
<https://www.ncbi.nlm.nih.gov/pubmed/20463494>
14. Ekstrand, J, et al. "Comparison of injuries sustained on artificial turf and grass by male and female elite football players." *Scandinavian Journal of Medicine and Science in Sports* (2011) 21: 824-832.  
<https://www.ncbi.nlm.nih.gov/pubmed/20456680>

## VIII. Other Health Effects

1. Zuccaro, P, et al. "Artificial turf and crumb rubber infill: An international policy review concerning the current state of regulations." *Environmental Challenges* (2022) 9:100620. <https://pubmed.ncbi.nlm.nih.gov/36644410/>
2. Landrigan, PJ, et al. "The Impact of Plastics on Human Health." *Annals of Global Health*, The Minderoo-Monaco Commission on Plastics and Human Health (2023) 89:1 23. <https://pubmed.ncbi.nlm.nih.gov/36969097/>
3. Saha, SC, et al. "Effect of microplastics deposition on human lung airways: A review with computational benefits and challenges." *Helion* (2024) 10:2. <https://pubmed.ncbi.nlm.nih.gov/38293398/#:~:text=Research%20has%20indicated%20tha>



[t%20microplastics,where%20gas%20exchange%20takes%20place.](#)

4. Zachariah, JP, et al. "Environmental Exposures and Pediatric Cardiology: A Scientific Statement from the American Heart Association." *American Heart Association Journal of Circulation* (2024) 149:20. <https://www.ahajournals.org/doi/10.1161/CIR.0000000000001234>
5. Hollóczki, O, et al. "Can Nanoplastics Alter Cell Membranes?" *Chemphyschem* (2020) 21:19-12. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6973106/>
6. González-Acedo, A, et al. "Evidence from in vitro and in vivo studies on the potential health repercussions of micro- and nanoplastics." *Chemosphere* (2021) 280:130826. <https://pubmed.ncbi.nlm.nih.gov/34162123/>

## IX. Reports and Articles

1. Toxics Use Reduction Institute. "Per- and Poly-fluoroalkyl Substances (PFAS) in Artificial Turf". *Toxics Use Reduction Institute*. (2020)  
<https://www.turi.org/content/download/12963/201149/file/TURI+fact+sheet+-+PFAS+in+artificial+turf.pdf>
2. Environmental Health Perspective: "Synthetic turf health debate takes root." *Environmental Health Perspectives* (2008) 16:3 116-122  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2265067/pdf/ehp0116-a00116.pdf>
3. Kleunen, MV, et al. "A microplastic used as infill material in artificial sport turfs reduces plant growth." *Plants People Planet* (2019) 2:3 157-166. [https://www.researchgate.net/publication/336426954\\_A\\_microplastic\\_used\\_as\\_infill\\_material\\_in\\_artificial\\_sport\\_turfs\\_reduces\\_plant\\_growth](https://www.researchgate.net/publication/336426954_A_microplastic_used_as_infill_material_in_artificial_sport_turfs_reduces_plant_growth)
4. U.S. Environmental Protection Agency, Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry, "Synthetic turf field recycled tire crumb rubber research under the federal research action plan final report: Part 1 - Tire Crumb Characterization (Volumes 1 and 2)." (EPA/600/R-19/051). (2019).  
[https://www.epa.gov/sites/default/files/2019-08/documents/synthetic\\_turf\\_field\\_recycled\\_tire\\_crumb\\_rubber\\_research\\_under\\_the\\_federal\\_research\\_action\\_plan\\_final\\_report\\_part\\_1\\_volume\\_1.pdf](https://www.epa.gov/sites/default/files/2019-08/documents/synthetic_turf_field_recycled_tire_crumb_rubber_research_under_the_federal_research_action_plan_final_report_part_1_volume_1.pdf)
5. U.S. Environmental Protection Agency, Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry, "Synthetic turf field recycled tire crumb rubber research under the federal research action plan final report: Part 2 - Tire Crumb Characterization (April 2024)  
<https://www.epa.gov/chemical-research/tire-crumb-exposure-characterization-report-volumes-1-and-2>

*Compilation prepared by Grassroots Environmental Education, Inc.,  
184 Main Street, Port Washington, New York 11050.  
www.grassrootsinfo.org*

7/24 DW