



**Current Issues:
Synthetic Turf**

Independent Science on Public Health Concerns Regarding Synthetic Turf

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I. Crumb Rubber Chemicals

A. 1,3 Butadiene

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1. "Development of a unit risk factor for 1, 3-butadiene based on an updated carcinogenic toxicity assessment." Grant, RL, et al. *Risk analysis* 29:12 (2009) 1726-1742.
2. "Risk of leukemia in relation to exposure to ambient air toxics in pregnancy and early childhood." Heck, JE, et al. *International journal of hygiene and environmental health* 217:6 (2014) 662-668.
3. "Epigenetic alterations in liver of C57BL/6J mice after short-term inhalational exposure to 1, 3-butadiene." Koturbash, I, et al. *Environmental health perspectives* 119:5 (2011) 635.
4. "Childhood lymphohematopoietic cancer incidence and hazardous air pollutants in southeast Texas, 1995–2004." Whitworth, KW, E Symanski and AL Coker. *Environmental health perspectives* 116:11 (2008) 1576.
5. "Health risk assessment of personal inhalation exposure to volatile organic compounds in Tianjin, China." Zhou, J, et al. *Science of the total environment* 409:3 (2011) 452-459.

B. Arsenic

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1. "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." Chen, Y, et al. *Toxicology and applied pharmacology* 239:2 (2009) 184-192.
2. "Low-dose arsenic compromises the immune response to influenza A infection in vivo." Kozul, CD, et al. *Environmental health perspectives* 117:9 (2009) 1441.

3. **"Association between exposure to low to moderate arsenic levels and incident cardiovascular disease: A prospective cohort study."** Moon, KA., et al. *Annals of internal medicine* 159:10 (2013) 649-659.
4. **"The broad scope of health effects from chronic arsenic exposure: update on a worldwide public health problem."** Naujokas, MF, et al. *Environmental health perspectives* 121:3 (2013) 295.
5. **"Long-term low-level arsenic exposure is associated with poorer neuropsychological functioning: a Project FRONTIER study."** O'Bryant, SE, et al. *International journal of environmental research and public health* 8:3 (2011) 861-874.
6. **"Arsenic exposure and motor function among children in Bangladesh."** Parvez, F, et al. *Environmental health perspectives* 119:11 (2011) 1665.
7. **"Increased lung cancer risks are similar whether arsenic is ingested or inhaled."** Smith, AH, et al. *Journal of exposure science and environmental epidemiology* 19:4 (2009) 343-348.
8. **"Arsenic exposure transforms human epithelial stem/progenitor cells into a cancer stem-like phenotype."** Tokar, EJ, BA Diwan and MP Waalkes. *Environmental health perspectives* 118:1 (2010) 108.
9. **"Health effects of early life exposure to arsenic."** Vahter, Marie. *Basic and clinical pharmacology & toxicology* 102:2 (2008) 204-211.
10. **"Kidney cancer mortality: fifty-year latency patterns related to arsenic exposure."** Yuan, Yan, et al. *Epidemiology* 21:1 (2010) 103-108.

C. Arylamines

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1. **"Cancer incidence and mortality among workers exposed to benzidine."** Brown, SC, R Alberts, and M Schoenberg. *American journal of industrial medicine* 54:4 (2011) 300-306.
2. **"Cancer mortality and occupational exposure to aromatic amines and inhalable aerosols in rubber tire manufacturing in Poland."** de Vocht, F, et al. *Cancer epidemiology* 33:2 (2009) 94-102.
3. **"Establishing a total allowable concentration of o-toluidine in drinking water incorporating early lifestage exposure and susceptibility."** English, JC, et al. *Regulatory toxicology and pharmacology* 64:2 (2012) 269-284.
4. **"Biomonitoring of human exposure to arylamines."** Richter, E. *Frontiers in bio-science* 7 (2015) 222-238.
5. **"Elevated 4-aminobiphenyl and 2, 6-dimethylaniline hemoglobin adducts and increased risk of bladder cancer among lifelong nonsmokers—The Shanghai Bladder Cancer Study."** Tao, L, et al. *Cancer epidemiology and prevention biomarkers* 22:5 (2013) 937-945.

D. Benzene

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1. **"Urinary biomarkers of exposure and of oxidative damage in children exposed to low airborne concentrations of benzene."** Andreoli, R, et al. *Environmental research* 142 (2015) 264-272.
2. **"Current understandings and perspectives on non-cancer health effects of benzene: a global concern."** Bahadar, H, S Mostafalou, and M Abdollahi. *Toxicology and applied pharmacology* 276:2 (2014) 83-94.
3. **"Acute childhood leukaemia and residence next to petrol stations and automotive repair garages: the ESCALE study (SFCE)."** Brosselin, P, et al. *Occupational and environmental medicine* 66:9 (2009) 598-606.
4. **"Airways changes related to air pollution exposure in wheezing children."** Martins, PC, et al. *European respiratory journal* 39:2 (2012) 246-253.
5. **"Global gene expression profiling of a population exposed to a range of benzene levels."** McHale, CM, et al. *Environmental health perspectives* 119:5 (2011) 628.
6. **"Effects of toluene and benzene air mixtures on human lung cells (A549)."** Pariselli, F, et al. *Experimental and toxicologic pathology* 61:4 (2009) 381-386.
7. **"Exposure to benzene in various susceptible populations: co-exposures to 1, 3-butadiene and PAHs and implications for carcinogenic risk."** Ruchirawat, M, P Navasumrit, and D Settachan. *Chemico-biological interactions* 184:1 (2010) 67-76.
8. **"Leukemia and benzene."** Snyder, R. *International journal of environmental research and public health* 9:8 (2012) 2875-2893.
9. **"Benzene exposure near the US permissible limit is associated with sperm aneuploidy."** Xing, C, et al. *Environmental health perspectives* 118:6 (2010) 833.

E. Benzothiazoles

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1. **"Tire tread wear particles in ambient air—a previously unknown source of human exposure to the biocide 2-mercaptobenzothiazole."** Avagyan, R, et al. *Environmental science and pollution research international* 21:19 (2014) 11580-6.
2. **"Characterization of substances released from crumb rubber material used on artificial turf fields."** Li, X, et al. *Chemosphere* 80:3 (2010) 279-285.
3. **"Benzothiazoles in indoor air from Albany, New York, USA, and its implications for inhalation exposure."** Wan, Y, J Xue, and K Kannan. *Journal of hazardous materials* 311 (2016) 37-42.
4. **"Common and consumer products contain activators of the aryl hydrocarbon (dioxin) receptor."** Zhao, B, et al. *PLoS One* 8:2 (2013).

F. Butylated Hydroxyanisole (BHA)

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1. **"Environmental factors and allergic diseases."** Jenerowicz, D, et al. *Annals of agricultural and environmental medicine* 19:3 (2012).
2. **"In vitro study of calf thymus DNA interaction with butylated hydroxyanisole."** Kashanian, S, and JEN Dolatabadi. *DNA and cell biology* 28:10 (2009) 535-540.
3. **"Evaluation of the possible endocrine disruptive effect of butylated hydroxyanisole, butylated hydroxytoluene and propyl gallate in immature female rats."** Pop, A, et al. *Farmacia* 61:1 (2013) 202-211.
4. **"Cytotoxicity and DNA fragmentation properties of butylated hydroxyanisole."** Vandghanooni, S, et al. *DNA and cell biology* 32:3 (2013) 98-103.

G. Cadmium

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1. **"Cadmium exposure and cancer mortality in the Third National Health and Nutrition Examination Survey cohort."** Adams, SV, MN Passarelli, and PA Newcomb. *Occupational environmental medicine* 69:2 (2012) 153-156.
2. **"Low level exposure to cadmium increases the risk of chronic kidney disease: analysis of the NHANES 1999-2006."** Ferraro, PM, et al. *BMC public health* 10:1 (2010) 304.
3. **"Environmental cadmium and breast cancer risk."** Gallagher, CM, JJ Chen, and JS Kovach. *Aging (Albany NY)* 2:11 (2010) 804.
4. **"Cadmium exposure and cancer mortality in a prospective cohort: the strong heart study."** García-Esquinas, E, et al. *Environmental health perspectives* 122:4 (2014) 363.
5. **"Low-level environmental cadmium exposure is associated with DNA hypomethylation in Argentinean women."** Hossain, MB, et al. *Environmental health perspectives* 120:6 (2012) 879.
6. **"Effects of long-term low-dose cadmium exposure on genomic DNA methylation in human embryo lung fibroblast cells."** Jiang, G, et al. *Toxicology* 244:1 (2008) 49-55.
7. **"Heavy metal poisoning: the effects of cadmium on the kidney."** Johri, N, G Jacquillet, and R Unwin. *Biometals* 23:5 (2010) 783-792.
8. **"Early-life cadmium exposure and child development in 5-year-old girls and boys: a cohort study in rural Bangladesh."** Kippler, M, et al. *Environmental health perspectives* 120:10 (2012) 1462.
9. **"Cadmium exposure in the population: from health risks to strategies of prevention."** Nawrot, TS, et al. *Biometals* 23:5 (2010) 769-782.
10. **"Cadmium exposure in association with history of stroke and heart failure."** Peters, JL, et al. *Environmental research* 2110:2 (2010) 199-206.
11. **"Cadmium exposure and neuropsychological development in school children in southwestern Spain."** Rodríguez-Barranco, M, et al. *Environmental research* 134 (2014) 66-73.
12. **"Cadmium, environmental exposure, and health outcomes."** Satarug, S et al. *Environmental health perspectives* 118 (2010) 182-190.
13. **"Cadmium exposure and all-cause and cardiovascular mortality in the US general population."** Tellez-Plaza, M, et al. *Environmental health perspectives* 120:7 (2012) 1017.

H. Carbon Black

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1. **"Carbon black nanoparticle instillation induces sustained inflammation and genotoxicity in mouse lung and liver."** Bourdon, JA, et al. *Particle and fibre toxicology* 9:1 (2012).
2. **"Hepatic and pulmonary toxicogenomic profiles in mice intratracheally instilled with carbon black nanoparticles reveal pulmonary inflammation, acute phase response, and alterations in lipid homeostasis."** Bourdon, JA, et al. *Toxicological sciences* 127:2 (2012) 474-484.
3. **"Carbon black and titanium dioxide nanoparticles elicit distinct apoptotic pathways in bronchial epithelial cells."** Hussain, S, et al. *Particle and fibre toxicology* 7:1 (2010).
4. **"Mutation spectrum in FE1-MUTA(TM) Mouse lung epithelial cells exposed to nanoparticulate carbon black."** Jacobsen, NR, et al. *Environmental and molecular mutagenesis* 52:4 (2011) 331-337.
5. **"Symptoms of respiratory disease and lung functional impairment associated with occupational inhalation exposure to carbon black dust."** Neghab, M, MH Mohraz, and J Hassanzadeh. *Journal of occupational health* 53:6 (2011) 432-438.
6. **"Induction of inflammasome-dependent pyroptosis by carbon black nanoparticles."** Reisetter, AC, et al. *Journal of biological chemistry* 286:24 (2011) 21844-21852.
7. **"Inhalation of carbon black nanoparticles aggravates pulmonary inflammation in mice."** Saputra, D, et al. *Toxicological research* 30:2 (2014) 83.
8. **"Carbon black nanoparticles and vascular dysfunction in cultured endothelial cells and artery segments."** Vesterdal, LK, et al. *Toxicology letters* 214:1 (2012) 19-26.
9. **"Reduced pulmonary function and increased pro-inflammatory cytokines in nanoscale carbon black-exposed workers."** Zhang, R, et al. *Particle and fibre toxicology* 11:1 (2014) 73.

I. Lead

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1. **"CDC updates guidelines for children's lead exposure."** *Environmental health perspectives* 120:7 (2012). Betts, KS. *Environmental health perspectives* 120:7 (2012).
2. **"Lead poisoning in children."** Dapul, H and D Laraque. *Advances in pediatrics* 61 (2014) 313-333.
3. **"The impact of low-level lead toxicity on school performance among children in the Chicago Public Schools: a population-based retrospective cohort study."** Evens, A, et al. *Environmental health* 14 (2015).
4. **"Neurobehavioural effects of developmental toxicity."** Grandjean, P and P Landrigan. *The Lancet neurology* 13:3 (2014) 330-338.
5. **"Low-level environmental lead exposure and intellectual impairment in children – the current concepts of risk assessment."** Jakubowski, M. *International journal of occupational medicine and environmental health* 24:1 (2011) 1-7.
6. **"Blood lead concentrations < 10 µg/dL and child intelligence at 6 years of age."** Jusko, TA, et al. *Environmental health perspectives* 116:2 (2008) 243-248.
7. **"Lead exposures in U.S. children, 2008: implications for prevention."** Levin, R, et al. *Environmental health perspectives* 116:10 (2008) 1285–1293.
8. **"Pb neurotoxicity: neuropsychological effects of lead toxicity."** Mason, LH, et al. *Biomed research international* 2014.
9. **"Evaluating and regulating lead in synthetic turf."** Van Ulirsch, G, et al. *Environmental health perspectives* 118:10 (2010) 1345–1349.

J. Manganese

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1. **"Manganese neurotoxicity: Lessons learned from longitudinal studies in nonhuman primates."** Burton NC and TR Guilarte. *Environmental health perspectives* 117:3 (2009) 325-332.
2. **"Manganese neurotoxicity: new perspectives from behavioral, neuroimaging, and neuropathological studies in humans and non-human primates."** Guilarte, TR. *Front aging neuroscience* 5 (2013).
3. **"Manganese neurotoxicity: a focus on glutamate transporters."** Karki, P, et al. *Annals of occupational and environmental medicine* 25 (2013).
4. **"Mechanisms of lead and manganese neurotoxicity."** Neala, A and TR Guilarte. *Toxicology research* 2:2 (2013) 99–114.

K. Mercury

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1. **"Mercury toxicity and treatment: A review of the literature."** Bernhoft, RA. *Journal of environmental and public health* (2012).
2. **"Mercury exposure and children's health."** Bose-O'Reilly, S, et al. *Current problems in pediatric and adolescent health care* 40:8 (2010) 186-215.
3. **"Testicular toxicity in mercuric chloride treated rats: association with oxidative stress."** Boujbiha, MA, et al. *Reproductive toxicology* 28:1 (2009) 81-89.
4. **"Mercury and human genotoxicity: critical considerations and possible molecular mechanisms."** Crespo-Lopez, ME, et al. *Pharmacological research* 60:4 (2009) 212-220.
5. **"Is low-level environmental mercury exposure of concern to human health?"** Holmes, P, et al. *Science of the total environment* 408:2 (2009) 171-182.
6. **"Human exposure and health effects of inorganic and elemental mercury."** Park, J and W Zheng. *Journal of preventive medicine & public health* 45:6 (2012) 344–352.
7. **"Environmental mercury and its toxic effects."** Rice, KM, et al. *Journal of preventive medicine & public health* 47:2 (2014) 74-83.

L. Phenols

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1. **"Histopathologic effects of maternal 4-tert-octylphenol exposure on liver, kidney and spleen of rats at adulthood."** Barlas, N and M Aydoğan. *Archives of toxicology* 83:4 (2009) 341-349.
2. **"Exposure of the U.S. population to bisphenol A and 4-tertiary-octylphenol: 2003–2004."** Calafat, AM, et al. *Environmental health perspectives* 116:1 (2008) 39-44.
3. **"Embryonic exposure to octylphenol induces changes in testosterone levels and disrupts reproductive efficiency in rats at their adulthood."** Sainath, SB, et al. *Food and chemical toxicology* 49:4 (2011) 983-990.
4. **"An in vivo assessment of the genotoxic potential of bisphenol A and 4-tertiary-octylphenol in rats."** Ulutas, OK, et al. *Archives of toxicology* 85 (2011) 995-1001.
5. **"Hepatic and renal functions in growing mal rats after bisphenol A and octylphenol exposure."** Yildiz, N. and N Barlas. *Human and experimental technology* 32:7 (2013) 675-686.

M. Phthalates

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1. **"Childhood exposure to phthalates: associations with thyroid function, insulin-like growth factor I, and growth."** Boas, Malene, et al. *Environmental health perspectives* 118:10 (2010).
2. **"Phthalate exposure and asthma in children."** Bornehag, CG, and E Nanberg. *International journal of andrology* 33:2 (2010) 333-345.

3. **"Relationship between environmental phthalate exposure and the intelligence of school-age children."** Cho, S, et al. *Environmental health perspectives* 118:7 (2010) 1027.
4. **"Association between phthalates and attention deficit disorder and learning disability in US children, 6–15 years."** Chopra, V, et al. *Environmental research* 128 (2014) 64-69.
5. **"Phthalate exposure in girls during early puberty."** Chou, Y, et al. *Journal of pediatric endocrinology and metabolism* 22:1 (2009) 69-78.
6. **"Phthalates exposure and attention-deficit/hyperactivity disorder in school-age children."** Kim, B, et al. *Biological psychiatry* 66:10 (2009) 958-963.
7. **"Exposure to phthalates in 5–6 years old primary school starters in Germany—a human biomonitoring study and a cumulative risk assessment."** Koch, HM, et al. *International journal of hygiene and environmental health* 214:3 (2011) 188-195.

N. Polycyclic Aromatic Hydrocarbons (PAHs)

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1. **"Exposures to particulate matter and polycyclic aromatic hydrocarbons and oxidative stress in schoolchildren."** Bae, S, et al. *Environmental health perspectives* 118:4 (2010) 579.
2. **"Prenatal exposure to airborne polycyclic aromatic hydrocarbons and children's intelligence at 5 years of age in a prospective cohort study in Poland."** Edwards, SC, et al. *Environmental health perspectives* 118:9 (2010).
3. **"Air pollution in relation to US cancer mortality rates: an ecological study; likely role of carbonaceous aerosols and polycyclic aromatic hydrocarbons."** Grant, William B. *Anticancer research* 29:9 (2009) 3537-3545.
4. **"Assessment of benzo (a) pyrene-equivalent carcinogenicity and mutagenicity of residential indoor versus outdoor polycyclic aromatic hydrocarbons exposing young children in New York City."** Jung, KH, et al. *International journal of environmental research and public health* 7.5 (2010) 1889-1900.
5. **"A review of airborne polycyclic aromatic hydrocarbons (PAHs) and their human health effects."** Kim, K, et al. *Environment international* 60 (2013) 71-80.
6. **"Polycyclic aromatic hydrocarbons—aromatic DNA adducts in cord blood and behavior scores in New York City children."** Perera, FP, et al. *Environmental health perspectives* 119:8 (2011) 1176.

O. Styrene

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1. **"Indicators of oxidative stress and apoptosis in mouse whole lung and Clara cells following exposure to styrene and its metabolites."** Harvilchuck, JA, et al. *Toxicology* 264:3 (2009) 171-178.
2. **"Styrene exposure and risk of cancer."** Huff, J, and PF Infante. *Mutagenesis* 26:5 (2011): 583-584.
3. **"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."** Mögel, I, et al. *Toxicology* 289:1 (2011) 28-37.
4. **"Styrene induces an inflammatory response in human lung epithelial cells via oxidative stress and NF-κB activation."** Roder-Stolinkis, C, et al. *Toxicology and applied pharmacology* 231:2 (2008) 241-247.
5. **"Genetic effects and biotoxicity monitoring of occupational styrene exposure."** Rueff, J, et al. *Clinica chimica acta* 399.1 (2009) 8-23.
6. **"Pulmonary function and oxidative stress in workers exposed to styrene in plastic factory: Occupational hazards in styrene-exposed plastic factory workers."** Sati, PC. *Human and experimental toxicology* 30:11 (2011) 1743-1750.
7. **"Low level occupational exposure to styrene: its effects on DNA damage and DNA repair."** Wongvijitsuk, S, et al. *International journal of hygiene and environmental health* 214.2 (2011) 127-137.

P. Toluidine

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1. **"DNA adducts of ortho-toluidine in human bladder."** Böhm, F, et al. *Biomarkers* 16:2 (2011) 120-128.
2. **"Bladder cancer incidence among workers exposed to o-toluidine, aniline and nitrobenzene at a rubber chemical manufacturing plant."** Carreón, T, et al. *Occupational Environmental Medicine* (2013).
3. **"Bladder cancer risks in workers manufacturing chemicals for the rubber industry."** Sorahan, Tom. *Occupational medicine* 58:7 (2008) 496-501.

Q. Trichloroethylene

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1. **"Developmental exposure to trichloroethylene promotes CD4+ T cell differentiation and hyperactivity in association with oxidative stress and neurobehavioral deficits in MRL+/+ mice."** Blossom, SJ, et al. *Toxicology and applied pharmacology* 231:3 (2008) 344-353.
2. **"Metabolic changes and DNA hypomethylation in cerebellum are associated with behavioral alterations in mice exposed to trichloroethylene postnatally."** Blossom, SJ, et al. *Toxicology and applied pharmacology* 269:3 (2013) 263-269.
3. **"Chronic exposure to trichloroethene causes early onset of SLE-like disease in female MRL+/+ mice."** Cai, P, et al. *Toxicology and applied pharmacology* 228:1 (2008) 68-75.
4. **"Human health effects of trichloroethylene: key findings and scientific issues."** Chiu, WA, et al. *Environmental health perspectives* 121:3 (2013) 303.

5. **"Evidence of autoimmune-related effects of trichloroethylene exposure from studies in mice and humans."** Cooper, GS, et al. *Environmental health perspectives* 117:5 (2009) 696.
6. **"Possible involvement of oxidative stress in trichloroethylene-induced genotoxicity in human HepG2 cells."** Hu, C, et al. *Mutation research/genetic toxicology and environmental mutagenesis* 29:1 (2008) 88–94.
7. **"Trichloroethylene-induced gene expression and DNA methylation changes in B6C3F1 mouse liver."** Jiang, Y, et al. *PLoS ONE* 9:12 (2014).
8. **"Occupational trichloroethylene exposure and risk of lymphatic and haematopoietic cancers: a meta-analysis."** Karami S, et al. *Occupational and environmental medicine* 70 (2013) 591-599.
9. **"Effect of trichloroethylene (TCE) toxicity on the enzymes of carbohydrate metabolism, brush border membrane and oxidative stress in kidney and other rat tissues."** Khan, S, et al. *Food and Chemical Toxicology* 47:7 (2009) 1562-1568.
10. **"Occupational exposure to trichloroethylene is associated with a decline in lymphocyte subsets and soluble CD27 and CD30 markers."** Lan, Q, et al. *Carcinogenesis* 31:9 (2010) 1592–1596.
11. **"Trichloroethylene biotransformation and its role in mutagenicity, carcinogenicity and target organ toxicity."** Lash, LH, et al. *Mutation research/reviews in mutation research* 762 (2014) 22–36.
12. **"A case–control study of occupational exposure to trichloroethylene and non-Hodgkin lymphoma."** Purdue, MP, et al. *Environmental health perspectives* 119:2 (2011) 232.
13. **"Trichloroethylene: Mechanistic, epidemiologic and other supporting evidence of carcinogenic hazard."** Rusyn, I, et al. *Pharmacology & therapeutics* 141:1 (2014) 55-68.
14. **"Trichloroethylene and cancer: systematic and quantitative review of epidemiologic evidence for identifying hazards."** Siegel Scott, C, and J Jinot. *International journal of environmental research and public health* 8:11 (2011) 4238-4271.

II. Bioaccessibility

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1. **"Health risk assessment of lead ingestion exposure by particle sizes in crumb rubber on artificial turf considering bioavailability."** Kim, S, et al. *Environmental health and technology* 27: (2012) 10.
2. **"Release of polycyclic aromatic hydrocarbons and heavy metals from rubber crumb in synthetic turf fields: preliminary hazard assessment for athletes."** Marsili, L, et al. *Environmental and analytical toxicology* 5:2 (2015).
3. **"Bioaccessibility and risk of exposure to metals and SVOCs in artificial turf field fill materials and fibers."** Pavilonis, BT, et al. *Risk analysis* 44: (2014) 44-55.
4. **"Hazardous chemicals in synthetic turf materials and their bioaccessibility in digestive fluids."** Zhang, J, et al. *Journal of exposure science and environmental epidemiology* 18: (2008) 600-607.

III. Heat Effects

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1. **"Policy Statement – Climatic Heat Stress and Exercising Children and Adolescents."** American Academy of Pediatrics: Council on Sports Medicine and Fitness and Council on School Health. *Pediatrics* 128:3 (2011) 741-747.
2. **"Temperature amelioration of synthetic turf surfaces through irrigation."** McNitt, AS, et al. The Pennsylvania State University. *Acta hort* 783: (2008) 573-582.
3. **"Synthetic turf heat evaluation – progress report."** Penn State's Center for Sports Surface Research. (2012).
4. **"Models for predicting surface temperatures on synthetic playing surfaces."** Thoms, AW, et al. *Procedia engineering* 72: (2014) 895-900.
5. **"Synthetic turf heat studies."** Williams, C, and G Pulley. Brigham Young University (2006).

IV. Injuries

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1. **"Football injuries on synthetic turf fields."** Akkaya, S, et al. *Joint diseases and related surgery* 69:1 (2012) 35-40.
2. **"Incidence of injury among adolescent soccer players: a comparative study of artificial and natural grass turfs."** Aoki, H, et al. *Clinical journal of sport medicine* 20:1 (2010).
3. **"Risk of anterior cruciate ligament injury in athletes on synthetic playing surfaces: A systematic review."** Balazs, GC, et al. *American journal of sports medicine* 43:7 (2014) 1798-1804.
4. **"A prospective analysis of the injury incidence of young male professional football players on artificial turf."** Bainco, A, et al. *Asian journal of sports medicine* 7:1 (2016).
5. **"The effect of playing surface on injury rate: a review of the current literature."** Drago, JL, and HJ Braun. *Sports medicine* 40:11 (2010) 981-990.
6. **"Synthetic playing surfaces and athlete health."** Drakos, M, et al. *Journal of the American academy of orthopaedic surgeons* 21:5: (2013) 293-302.
7. **"Comparison of injuries sustained on artificial turf and grass by male and female elite football players."** Ekstrand, J, et al. *Scandinavian journal of medicine and science in sports* 21: (2011) 824-832.

8. **"Effect of changes in artificial turf on sports injuries in male university soccer players."** Fujitaka, K, et al. *The orthopaedic journal of sports medicine* 5:8 (2017).
9. **"Incidence and risk factors for turf toe injuries in intercollegiate football: data from the national collegiate athletic association injury surveillance system."** George, E, et al. *Foot & ankle international* 35:2 (2014) 108-115.
10. **"Safety of third-generation artificial turf in male elite professional soccer players in Italian major league."** Lanzetti, RM, et al. *Scandinavian journal of medicine and science in sports* 27: (2017) 435-439.
11. **"The influence of playing surface on injury risk in Italian elite rugby players."** Lanzetti, RM, et al. *Muscles, ligaments and tendons journal* 7:1 (2017) 180-185.
12. **"Incidence, mechanisms, and severity of match-related collegiate women's soccer injuries on FieldTurf and natural grass surfaces: A 5-year prospective study."** Meyers, MC. *The American journal of sports medicine* 41:10 (2013) 2409-2420.
13. **"Incidence, mechanisms, and severity of match-related collegiate men's soccer injuries on FieldTurf and natural grass surfaces: A 6-Year prospective study."** Meyers, MC. *The American journal of sports medicine* 45:3 (2016) 708-718.
14. **"The perceptions of professional soccer players on the risk and injury from competition and training on natural turf grass and 3rd generation artificial turf."** Poulos, C, et al. *BMC sports science, medicine and rehabilitation* 6:11: (2014).
15. **"Influence of cleats-surface interaction on the performance and risk of injury in soccer: a systemic review."** Silva, DCF, et al. *Applied bionics and biomechanics* (2017).
16. **"Natural turf surfaces: the case for continued research."** Stiles, VH, et al. *Sports medicine* 39:1 (2009) 65-84.
17. **"A review of synthetic playing surfaces, the shoe-surface interface, and lower extremity injuries in athletes."** Taylor, SA, et al. *The physician and sports medicine* 40:4 (2012) 66-72.
18. **"Understanding the acute skin injury mechanism caused by player-surface contact during soccer: A survey and systemic review."** van den Eijne, Wilbert AJ, et al. *The orthopaedic journal of sports medicine* 2:5 (2014).
19. **"A review of football injuries on third and fourth generation artificial turfs compared with natural turf."** Williams, S, et al. *Sports medicine* 41:11 (2011) 903-923.
20. **"Playing field issues in sports medicine."** Wright, JM and David Webner. *Current sports medicine reports* 9:3 (2010) 129-133.

V. Flame Retardants (PBDEs)

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1. **"PBDE flame retardants, thyroid disease, and menopausal status in U.S. women."** Allen, JG, et al. *Environmental health perspectives* 15:1 (2016) 60.
2. **"Polybrominated diphenyl ether (PBDE) flame retardants and thyroid hormone during pregnancy."** Chevrier, J, et al. *Environmental health perspectives* 118:10 (2010) 1444-1449.
3. **"In utero and childhood polybrominated diphenyl ether (PBDE) exposures and neurodevelopment in the CHAMACOS study."** Eskenazi, B, et al. *Environmental health perspectives* 121:5 (2013) 257-262.
4. **"Developmental exposure to a commercial PBDE mixture: effects on protein networks in the cerebellum and hippocampus of rats."** Kodavanti, PR, et al. *Environmental health perspectives* 125:5 (2015) 428-436.
5. **"Prenatal exposure to polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) may influence birth weight among infants in a Swedish cohort with background exposure: a cross-sectional study."** Lingnell, S, et al. *Environmental health perspectives* 12:44 (2013).
6. **"Prenatal and childhood polybrominated diphenyl ether (PBDE) exposure and attention and executive function at 9-12 years of age."** Sagiv, SK, et al. *Neurotoxicology and teratology* 52 (2015) 151-161.
7. **"Prenatal PBDE and PCB exposures and reading, cognition, and externalizing behavior in children."** Zhang, H, et al. *Environmental Health Perspectives* 125:4 (2017) 746-752.
8. **"Correlation between prenatal exposure to polybrominated diphenyl ethers (PBDEs) and infant birth outcomes: a meta-analysis and an experimental study."** Zhao, X, et al. *International journal of environmental research and public health* 17:3 (2017).

VI. Disinfectants and Sanitizers

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1. **"Association between cleaning-related chemicals and work-related asthma and asthma symptoms among healthcare professionals."** Arif, AA and GL Delclos. *Occupational and environmental medicine* 69:1 (2012) 35-40.
2. **"Developmental neurotoxicity of different pesticides in PC-12 cells *in vitro*."** Christen, V, et al. *Toxicology and applied pharmacology* 325 (2017) 25-36.
3. **"Asthma among workers in healthcare settings: role of disinfection with quaternary ammonium compounds."** Gonzalez, M, et al. *Clinical and experimental allergy* 44:3 (2014) 393-406.
4. **"Ambient and dosed exposure to quaternary ammonium disinfectants causes neural tube defects in rodents."** Hrubec, TC, et al. *Birth defects research* 109:14 (2017) 1166-1178.
5. **"Exposure to common quaternary ammonium disinfectants decreases fertility in mice."** Melin, VE, et al. *Reproductive toxicology* 50 (2014) 163-170.
6. **"Quaternary ammonium disinfectants cause subfertility in mice by targeting both male and female reproductive processes."** Melin, VE, et al. *Reproductive toxicology* 59 (2016) 159-166.

7. **"Quaternary Ammonium Compounds in Cleaning Products: Health & Safety Information for Health Professionals."** Mount Sinai Selikoff Centers for Occupational Health and Bellevue/NYU Occupational and Environmental Medicine Clinic. September 2015.
8. **"Cleaning agents and asthma."** Quirce, S and P Barranco. *Journal of investigational allergology and clinical immunology* 20:7 (2010) 542-550.
9. **"Asthma related to cleaning agents: a clinical insight."** Vandenplas, O, et al. *British medical journal open* 3:9 (2013).
10. **"Cleaning practices and cleaning products in nurseries and schools: to what extent can they impact indoor air quality?"** Wei, W, et al. *Indoor air* 24:4 (2016) 517-525.

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