

Artificial Food and Cosmetic Coloring – A Hidden Source of Toxic Metals

By

Debbie C. Lindgren, CIHom, B.A., M.B.A

www.bluedominoes.com

I never really thought twice about food coloring – and if I did, I thought how wonderful it was. Isn't it great that you can make a green cake, decorate Easter eggs, customize treats for children, make play dough, etc? It seemed like every label I checked had some type of food coloring in it, so that means it safe right? Unfortunately, the answer turned out to be a resounding NO!

Why was it that some members of my family reacted after eating foods with color? Was it my imagination? Was it something else in the food? What about other children whose parents shared the same concern? Why does one child become hyperactive, another get sleepy and yet a third break out in a rash? These questions haunted me and I needed to find out.

When we approached our pediatrician she mentioned that some parents believe there is a connection between colors and behavior and illness, but there was absolutely no evidence to support that food coloring was in any way responsible for either outcome. But she also was not able to provide data supporting that it was not detrimental, so I decided to keep looking. Eventually I heard of Dr. Feingold, purchased his books and read about the link he had made between hyperactivity and food coloring. A number of his patients improved or recovered by changing their diets, specifically eliminating salicylates and colorings. Dr. Feingold had quite a bit of data on Salicylates, but what really intrigued me was the link between colors and hyperactivity – what EXACTLY was in these colors?

Background

Artificial food colorings were first introduced after WWII when the chemical industry met with the food industry regarding using the chemical based colors since they were lower in cost than natural colors and had a longer shelf life. The safety of the colors was determined primarily from using LD-50 tests and the amount was then extrapolated to humans. At the time of approval, behavioral toxicology testing was not required by the FDA and therefore was not done on the artificial food colors.¹

The FDA and Food Colorings

The FDA's website proved to be a valuable database for food coloring information. The site provides precisely what is in each of the colors and is quite disturbing. I was personally horrified to learn that ALL artificial food colorings contain heavy metals such as lead and mercury as well as a myriad of chemicals.

One reason this was so disturbing was that one portion of the FDA had complete literature on the dangers of lead and the sources – however food coloring was not listed as a potential source of exposure. Another reason this was disturbing was the consideration of all the possibilities for exposure to artificial food colorings in any given day. For example, is your child drinking a sports drink or a fruit juice with coloring?

Does their antibiotic contain coloring? What about the macaroni and cheese you made for dinner last night? What are the cumulative effects of this exposure?

What Levels are Safe?

Most artificial food coloring contains lead, mercury, and arsenic. What amounts of these substances are considered safe? The Department of Health and Human Services reports minimal risk levels as follows:

Mercury

Mercuric Chloride (oral)	Acute: .007 mg/kg/day Intermediate: .002 mg/kg/day
Mercury (Inhalation)	Chronic: 0.0002 mg/m ³ (mg per cubic meter of air)

Lead

Air	EPA: 1.5 mcg/ m ³ WHO: .5 mcg/ m ³
Blood	Children 10 mcg/dL OSHA – written notification & medical exam: 40 mcg/dL OSHA – medical removal from exposure 50 mcg/DL
Food	FDA – Bottled drinking water: .005 mg/L

Arsenic

Arsenic (Oral)	Acute: .005 mg/day Chronic: .0003 mg/day	Endpoint: Gastrointestinal Endpoint: Dermal
----------------	---	--

Artificial Colors

Artificial Colors become even more of a concern because not only are they in our food products, but they are also in other daily use items such as lotion, shampoo, soaps, etc. Furthermore, the metal allotments in these cosmetic products are even higher than those allowed in food products. Table one provides metal and chemical information for each color used in food products. Table Two provides the same information for each color used in cosmetic products.

Table 1 – Artificial Food Coloring

Color Name	Heavy Metal Content	Chemical Content
FD&C Blue No. 1	Chromium not more than 50 ppm Maganese not more than 100 ppm Arsenic not more than 3 ppm Lead not more than 10 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 15.0%. Water-insoluble matter, not more than 0.2%. Leuco base, not more than 5%. Sum of o-, m-, and p-sulfobenzaldehydes, not more than 1.5%. N-Ethyl,N-(m-sulfobenzyl)sulfanilic acid, not more than 0.3%. Total color, not less than 85.0%

FD&C Blue No. 2	Lead not more than 10 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 15.0%. Water insoluble matter, not more than 0.4%. Isatin-5-sulfonic acid, not more than 0.4%. 5-Sulfoanthranilic acid, not more than 0.2%. Disodium salt of 2-(1,3-dihydro-3-oxo-7-sulfo-2H-indol-2-ylidene)-2,3-dihydro-3-oxo-1H-indole-5-sulfonic acid, not more than 18%. Sodium salt of 2-(1,3-dihydro-3-oxo-2H-indol-2-ylidene)-2,3-dihydro-3-oxo-1H-indole-5-sulfonic acid, not more than 2%. Total color, not less than 85.0%
FD&C Green No. 3	Chromium not more than 50 ppm Arsenic not more than 3 ppm Lead not more than 10 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 15.0%. Water-insoluble matter, not more than 0.2%. Leuco base, not more than 5 percent. The leuco base is oxidized with lead dioxide and acid or with dichromate and acid to form the dye. Sum of 2-,3-,4-formylbenzenesulfonic acids, sodium salts, not more than 0.5%. Sum of 3- and 4-[[ethyl(4-sulfophenyl)amino]methyl] benzenesulfonic acid, disodium salts, not more than 0.3%. 2-Formyl-5-hydroxybenzenesulfonic acid, sodium salt, not more than 0.5%. Total color, not less than 85.0%
Orange B.	Lead not more than 10 ppm Arsenic not more than 1 ppm	Volatile matter (at 135 deg.C.), not more than 6.0%. Chlorides and sulfates (calc. as the sodium salts), not more than 7.0%. Water insoluble matter, not more than 0.2%. Total color, not less than 87.0%
Citrus Red No. 2	Lead not more than 10 ppm Arsenic not more than 1 ppm	Volatile matter (at 100 deg.C.), not more than 0.5%. Water-soluble matter, not more than 0.3%. Matter insoluble in carbon tetrachloride, not more than 0.5%. Uncombined intermediates, not more than 0.05%. Total color, not less than 98.0%
FD&C Red No. 3	Lead not more than 10 ppm Arsenic not more than 3 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 13.0%. Water-insoluble matter, not more than 0.2%. Unhalogenated intermediates, total not more than 0.1%. Sodium iodide, not more than 0.4%. Triiodoresorcinol, not more than 0.2%. 2(2',4'-Dihydroxy-3', 5'-diiodobenzoyl) benzoic acid, not more than 0.2%. Monoiodofluoresceins not more than 1.0%. Other lower iodinated fluoresceins, not more than 9.0%. Total color, not less than 87.0%
FD&C Red No. 40	Lead not more than 10 ppm Arsenic not more than 3 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 14.0%. Water-insoluble matter, not more than 0.2%. Higher sulfonated subsidiary colors (as sodium salts), not more than 1.0%. Lower sulfonated subsidiary colors (as sodium salts), not more than 1.0%. Disodium salt of 6-hydroxy-5-[(2-methoxy-5-methyl-4-sulfophenyl)azo] - 8-(2-methoxy-5-methyl-4-sulfophenoxy)-2-naphthalenesulfonic acid, ≤ 1.0%. Sodium salt of 6-hydroxy-2-naphthalenesulfonic acid (Schaeffer's salt), ≤ .3%. 4-Amino-5-methoxy-o- toluenesulfonic acid, not more than 0.2%. Disodium salt of 6,6'-oxybis (2-naphthalene-sulfonic acid) ≤ 1.0%. Total color, not less than 85.0%

FD&C Yellow No. 5	Lead not more than 10 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 13.0%. Water-insoluble matter, not more than 0.2%. 4,4'-[4,5-Dihydro-5-oxo-4-[(4-sulfophenyl)hydrazono]-1H-pyrazol-1,3-diy]bis[benzenesulfonic acid], trisodium salt, not more than 1%. 4-[(4',5'-Disulfo[1,1'-biphenyl]-2-yl)hydrazono]-4,5-dihydro-5-oxo-1-(4-sulfophenyl)-1H-pyrazole-3-carboxylic acid, tetrasodium salt ≤ 1.0% Ethyl or methyl 4,5-dihydro-5-oxo-1-(4-sulfophenyl)-4-[(4-sulfophenyl)hydrazono]-1H-pyrazole-3-carboxylate, disodium salt, ≤ 1.0% Sum of 4,5-dihydro-5-oxo-1-phenyl-4-[(4-sulfophenyl)azo]-1H-pyrazole-3-carboxylic acid, disodium salt, and 4,5-dihydro-5-oxo-4-(phenylazo)-1-(4-sulfophenyl)-1H-pyrazole-3-carboxylic acid, disodium salt, ≤ .5% (4-sulfophenyl)-1H-pyrazole-3-carboxylic acid, disodium salt, ≤ .5% 4-Aminobenzenesulfonic acid, sodium salt, not more than 0.2%. 4,5-Dihydro-5-oxo-1-(4-sulfophenyl)-1H-pyrazole-3-carboxylic acid, disodium salt, ≤ 0.2% Ethyl or methyl 4,5-dihydro-5-oxo-1-(4-sulfophenyl)-1H-pyrazole-3-carboxylate, sodium salt, ≤ 0.1% 4,4'-(1-Triazene-1,3-diy)bis[benzenesulfonic acid], disodium salt, ≤ .005% 4-Aminoazobenzene, not more than 75 ppb. 4-Aminobiphenyl, not more than 5 ppb. Aniline, not more than 100 ppb. Azobenzene, not more than 40 ppb. Benzidine, not more than 1 ppb. 1,3-Diphenyltriazene, not more than 40 ppb. Total color, not less than 87.0%
-------------------	---	--

FD&C Yellow No. 6	Lead not more than 10 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 13.0%. Water insoluble matter, not more than 0.2 % Sodium salt of 4-aminobenzenesulfonic acid, not more than 0.2%. Sodium salt of 6-hydroxy-2-naphthalenesulfonic acid, not more than 0.3% Disodium salt of 6,6'-oxybis[2-naphthalenesulfonic acid], not more than 1.0% Disodium salt of 4,4'-(1-triazene-1,3-diy)bis[benzenesulfonic acid], ≤ .1% Sum of the sodium salt of 6-hydroxy-5-(phenylazo)-2-naphthalenesulfonic acid and the sodium salt of 4-[(2-hydroxy-1-naphthalenyl)azo]benzenesulfonic acid, not more than Sum of the trisodium salt of 3-hydroxy-4-[(4-sulfophenyl)azo]-2,7-naphthalenedisulfonic acid and other higher sulfonated subsidiaries, ≤ 5.0% 4-Aminoazobenzene, not more than 50 ppb. 4-Aminobiphenyl, not more than 15 ppb. Aniline, not more than 250 ppb. Azobenzene, not more than 200 ppb. Benzidine, not more than 1 ppb. 1,3-Diphenyltriazene, not more than 40 ppb. 1-(Phenylazo)-2-naphthalenol, not more than 10 ppm. Total color, not less than 87.0%
-------------------	---	---

Source: FDA ²

All of the above colorings are approved for general use in food with the exception of two colors. The first color, Orange B, is authorized for use only in casings or surfaces of frankfurters or sausages. Were you aware that these foods had colors in them? I certainly was not and that is very concerning. Even if you are consciously trying to avoid colors, you have to be extremely vigilant and check every label, because colors show up in seemingly innocent places.

The second color Citrus Red No. 2 is approved only for orange skins that are not intended for or used in processing – this means the oranges that we are going to sit down and eat. Again, here we are as parents, providing what we believe is a nutritious alternative for our children, only to learn that they can be laced with heavy metals.

Cosmetic Coloring

What do baby shampoos, lotions, and washes have in common? They are considered cosmetics and therefore can use FDA approved cosmetic coloring in their products.

What is interesting is the FDA has allowed for higher levels of metals in the cosmetics category. Table 2 presents the data for cosmetic coloring.

Table 2 – Artificial Cosmetic Coloring

Color Name	Heavy Metal Content	Chemical Content
D&C Black No. 2	Lead not more than 10 ppm Mercury not more than 1 ppm Arsenic no more than 3 ppm	Ash content, not more than 0.15 percent. Total sulfur, not more than 0.65% Total PAHs, not more than 500 ppb. Benzo[e]pyrene, not more than 5 ppb Dibenz[a,h]anthracene, not more than 5 ppb Total color (as carbon), not less than 95%.
D&C Brown No. 1	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Please see http://www.cfsan.fda.gov/~lrd/cf742151.html for complete list.
FD&C Blue No. 1	Chromium not more than 50 ppm Manganese not more than 100 ppm Arsenic not more than 3 ppm Lead not more than 10 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 15.0%. Water-insoluble matter, not more than 0.2%. Leuco base, not more than 5%. Sum of o-, m-, and p-sulfobenzaldehydes, not more than 1.5%. N-Ethyl,N-(m-sulfobenzyl)sulfanilic acid, not more than 0.3%. Total color, not less than 85.0%
D&C Blue No.4	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 15.0%. Water-insoluble matter, not more than 0.2% Leuco base, not more than 5% Sum of o-, m, and p- sulfobenzaldehydes, ammonium salt, ≤ 1.5% N-ethyl, N-(m- sulfobenzyl) sulfanilic acid ammonium salt, ≤ .3%
FD&C Green No. 3	Chromium not more than 50 ppm Arsenic not more than 3 ppm Lead not more than 10 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 15.0%. Water-insoluble matter, not more than 0.2%. Leuco base, not more than 5 percent. The leuco base is oxidized with lead dioxide and acid or with dichromate and acid to form the dye. Sum of 2-,3-,4-formylbenzenesulfonic acids, sodium salts, not more than 0.5% Sum of 3- and 4-[[ethyl(4-sulfophenyl)amino]methyl] benzenesulfonic acid, disodium salts, not more than 0.3%. 2-Formyl-5-hydroxybenzenesulfonic acid, sodium salt, not more than 0.5% Total color, not less than 85.0%
D&C Green No. 5	Information not available	Information not available.
D&C Green No. 6	Information not available	Information not available.
D&C Green No. 8	Information not available	Information not available.
D&C Orange No. 4	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 13.0%. Water-insoluble matter, not more than 0.2%. 2-Naphthol, not more than 0.4% Sulfanilic acid, sodium salt, not more than 0.2% Subsidiary colors, not more than 3% 4,4'-(Diazoamino)-dibzenesulfonic acid, not more than 0.1%
D&C Orange No. 5	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 10.0%. 4',5'-dibromofluorescein, not less than 50% and not more than 65% 2',4',5'-tribromofluorescein, not less than 30 % and not more than 40% Sum of 2',4'-dibromofluorescein and 2',5'-dibromofluorescein, not more 2% 4'-Bromofluorescein, not more than 2%. Fluorescein, not more than 1%. Phthalic acid, not more than 1%. 2-(3,5-Dibromo-2,4-dihydroxybenzoyl) benzoic acid, not more than 0.5%. Brominated resorcinol, not more than 0.4%.

D&C Orange No. 10	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 8.0%. Insoluble matter (alkaline solution), not more than 0.5%. Phthalic acid, not more than 0.5%. 2-[3',5'-Diiodo-2',4'-dihydroxybenzoyl] benzoic acid, not more than 0.5%. Fluorescein, not more than 1%. 4'-Iodofluorescein, not more than 3%. 2',4'-Diiodofluorescein and 2',5'-diiodofluorescein, not more than 2%. 2',4',5'-Triiodofluorescein, not more than 35%. 2',4',5',7'-Tetraiodofluorescein, not more than 10%. 4',5'-Diiodofluorescein, not less than 60 percent and not more than 95%.
D&C Orange No. 11	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 8.0%. Water-insoluble matter, not more than 0.5%. Phthalic acid, not more than 0.5 percent. 2-[3',5'-Diiodo-2',4'-dihydroxybenzoyl] benzoic acid, sodium salt, not more than .5% Fluorescein, disodium salt, not more than 1% 4'-Iodofluorescein, disodium salt, not more than 3% 2',4'-Diiodofluorescein and 2',5'-diiodofluorescein, not more than 2%. 2',4',5'-Triiodofluorescein, not more than 35%. 2',4',5',7'-Tetraiodofluorescein, disodium salt, not more than 10%. 4',5'-Diiodofluorescein, disodium salt, not less than 60% and not more than 95%.
FD&C Red No. 4	Lead not more than 10 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 13.0%. Water-insoluble matter, not more than 0.2%. 5-Amino-2,4-dimethyl-1-benzenesulfonic acid, sodium salt, not more than .2% 4-Hydroxy-1-naphthalenesulfonic acid, sodium salt, not more than 0.2%.
D&C Red No. 6	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 10.0%. 2-Amino-5-methylbenzenesulfonic acid, sodium salt, not more than 0.2%. 3-Hydroxy-2-naphthalenecarboxylic acid, sodium salt, not more than 0.4%. 3-Hydroxy-4-[(4-methylphenyl)azo]-2-naphthalenecarboxylic acid, sodium salt ≤ .5%. p- Toluidine, not more than 15 parts per million.
D&C Red No. 7	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 10.0%. 2-Amino-5-methylbenzenesulfonic acid, calcium salt, not more than 0.2% 3-Hydroxy-2-naphthalenecarboxylic acid, calcium salt, not more than 0.4% 3-Hydroxy-4-[(4-methylphenyl)azo]-2-naphthalenecarboxylic acid, calcium salt ≤ .5% p-Toluidine, not more than 15 parts per million.
D&C Red No. 17	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Volatile matter (at 275 degrees), not more than 5%. Matter insoluble in both toluene and water not more than 0.5% Chlorides and sulfates (calculated as sodium salts), not more than 3%. Aniline, not more than 0.2%. 4-Aminoazobenzene, not more than 0.1%. 2-Naphthol, not more than 0.2%. 1-(Phenylazo)-2-naphthol, not more than 3%. 1-[2-(phenylazo) phenyl]azo]-2-naphthalenol, not more than 2%.
D&C Red No. 21	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 135 deg.C) and halides and sulfates not more than 10% Insoluble matter (alkaline solution), not more than 0.5%. Phthalic acid, not more than 1%. 2-(3,5-Dibromo-2,4-dihydroxybenzoyl) benzoic acid, not more than 0.5% 2',4',5',7'-Tetrabromofluorescein, ethyl ester, not more than 1%. Brominated resorcinol, not more than 0.4%. Fluorescein, not more than 0.2%. Sum of mono- and dibromofluoresceins, not more than 2%.. Tribromofluoresceins, not more than 11%. 2',4',5',7'-Tetrabromofluorescein, not less than 87%.
D&C Red No. 22	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 135 deg.C) and halides and sulfates not more than 10% Water-insoluble matter not more than 0.5%. Disodium salt of phthalic acid, not more than 1%. Sodium salt of 2-(3,5-Dibromo-2,4-dihydroxybenzoyl)benzoic acid, not more than .5%. 2',4',5',7'-Tetrabromofluorescein, ethyl ester, not more than 1%. Brominated resorcinol, not more than 0.4%. Sum of disodium salts of mono- and dibromofluoresceins, not more than 2%. Sum of disodium salts of tribromofluoresceins, not more than 25%. Disodium salt of 2',4',5',7'-Tetrabromofluorescein, not less than 72%.

D&C Red No. 28	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 135 deg.C) and halides and sulfates not more than 15% Insoluble matter (alkaline solution), not more than 0.5%. Tetrachlorophthalic acid, not more than 1.2%. Brominated resorcinol, not more than 0.4%. 2,3,4,5-Tetrachloro-6-(3,5-dibromo-2,4-dihydroxybenzoyl) benzoic acid, ≤ .7% 2',4',5',7'-Tetrabromo-4,5,6,7-tetrachlorofluorescein, ethyl ester, ≤ 2%. Lower halogenated subsidiary colors, not more than 4%.
D&C Red No. 30	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Volatile matter (at 135 deg.C), not more than 5%. Chlorides and sulfates (calc. as sodium salts), not more than 3%. Matter soluble in acetone, not more than 5%.
D&C Red No. 31	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 10.0%. Aniline, not more than 0.2%. 3-Hydroxy-2-naphthoic acid, calcium salt, not more than 0.4%. Subsidiary colors, not more than 1%.
D&C Red No. 33	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 18%. Water-insoluble matter, not more than 0.3%. 4-Amino-5-hydroxy-2,7-naphthalenedisulfonic acid, disodium salt, not more than .3% 4,5-Dihydroxy-3-(phenylazo)-2,7-naphthalenedisulfonic acid, disodium salt ≤ 3%. Aniline, not more than 25 ppm 1,3-Diphenyltriazene, not more than 125 ppb 4-Aminobiphenyl, not more than 275 ppb Azobenzene, not more than 1 ppm Benzidine, not more than 20 ppb
D&C Red No. 34	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 15%. 2-Amino-1-naphthalenesulfonic acid, calcium salt, not more than 0.2% 3-Hydroxy-2-naphthoic acid, not more than 0.4% Subsidiary colors, not more than 4%.
D&C Red No. 36	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Volatile matter at 275 deg.F not more than 1.5%. Matter insoluble in toluene, not more than 1.5%. 2-Chloro-4-nitrobenzamine, not more than 0.3%. 2-Naphthalenol, not more than 1%. 2,4-Dinitrobenzamine, not more than 0.02%. 1-[(2,4-Dinitrophenyl)azo]-2-naphthalenol, not more than 0.5%. 4-[(2-Chloro-4-nitrophenyl)azo]-1-naphthalenol, not more than 0.5%. 1-[(4-Nitrophenyl)azo]-2-naphthalenol, not more than 0.3 percent. 1-[(4-Chloro-2-nitrophenyl)azo]-2-naphthalenol, not more than 0.3%.
FD&C Red No. 40	Lead not more than 10 ppm Arsenic not more than 3 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 14.0%. Water-insoluble matter, not more than 0.2%. Higher sulfonated subsidiary colors (as sodium salts), not more than 1.0% Lower sulfonated subsidiary colors (as sodium salts), not more than 1.0% Disodium salt of 6-hydroxy-5-[(2-methoxy-5-methyl-4-sulfophenyl) azo] - 8-(2-methoxy-5-methyl-4-sulfophenoxy)-2-naphthalenesulfonic acid, ≤ 1.0% Sodium salt of 6-hydroxy-2-naphthalenesulfonic acid (Schaeffer's salt), ≤ .3% 4-Amino-5-methoxy-o- toluenesulfonic acid, not more than 0.2% Disodium salt of 6,6'-oxybis (2-naphthalene-sulfonic acid), ≤ 1.0% Total color, not less than 85.0%
D&C Violet No. 2	Lead not more than 20 ppm Arsenic not more than 3 ppm	Volatile matter at 275 deg F, not more than 2.0%. Matter insoluble in both carbon tetrachloride and water, not more than .5% p- Toluidine, not more than 0.2%. 1-Hydroxy-9,10-anthracenedione, not more than 0.5%. 1,4-Dihydroxy-9,10-anthracenedione, not more than 0.5%. Subsidiary colors, not more than 1%.

FD&C Yellow No. 5	Lead not more than 10 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 13.0%. Water-insoluble matter, not more than 0.2%. 4,4'-[4,5-Dihydro-5-oxo-4-[(4-sulfophenyl)hydrazono]-1H-pyrazol-1,3-diyl]bis[benzenesulfonic acid], trisodium salt, not more than 1%. 4-[(4',5'-Disulfo[1,1'-biphenyl]-2-yl)hydrazono]-4,5-dihydro-5-oxo-1-(4-sulfophenyl)-1H-pyrazole-3-carboxylic acid, tetrasodium salt ≤ 1.0% Ethyl or methyl 4,5-dihydro-5-oxo-1-(4-sulfophenyl)-4-[(4-sulfophenyl)hydrazono]-1H-pyrazole-3-carboxylate, disodium salt, ≤ 1.0% Sum of 4,5-dihydro-5-oxo-1-phenyl-4-[(4-sulfophenyl)azo]-1H-pyrazole-3-carboxylic acid, disodium salt, and 4,5-dihydro-5-oxo-4-(phenylazo)-1-(4-sulfophenyl)-1H-pyrazole-3-carboxylic acid, disodium salt, ≤ .5% (4-sulfophenyl)-1H-pyrazole-3-carboxylic acid, disodium salt, ≤ .5% 4-Aminobenzenesulfonic acid, sodium salt, not more than 0.2%. 4,5-Dihydro-5-oxo-1-(4-sulfophenyl)-1H-pyrazole-3-carboxylic acid, disodium salt, ≤ 0.2% Ethyl or methyl 4,5-dihydro-5-oxo-1-(4-sulfophenyl)-1H-pyrazole-3-carboxylate, sodium salt, ≤ 0.1% 4,4'-(1-Triazene-1,3-diyl)bis[benzenesulfonic acid], disodium salt, ≤ .005% 4-Aminoazobenzene, not more than 75 ppb. 4-Aminobiphenyl, not more than 5 ppb. Aniline, not more than 100 ppb. Azobenzene, not more than 40 ppb. Benzidine, not more than 1 ppb. 1,3-Diphenyltriazene, not more than 40 ppb. Total color, not less than 87.0%
FD&C Yellow No. 6	Lead not more than 10 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of volatile matter (at 275 degrees) and chlorides and sulfates not more than 13.0%. Water insoluble matter, not more than 0.2 % Sodium salt of 4-aminobenzenesulfonic acid, not more than 0.2%. Sodium salt of 6-hydroxy-2-naphthalenesulfonic acid, not more than 0.3% Disodium salt of 6,6'-oxybis[2-naphthalenesulfonic acid], not more than 1.0% Disodium salt of 4,4'-(1-triazene-1,3-diyl)bis[benzenesulfonic acid], ≤ .1% Sum of the sodium salt of 6-hydroxy-5-(phenylazo)-2-naphthalenesulfonic acid and the sodium salt of 4-[(2-hydroxy-1-naphthalenyl)azo]benzenesulfonic acid, not more than Sum of the trisodium salt of 3-hydroxy-4-[(4-sulfophenyl)azo]-2,7-naphthalenedisulfonic acid and other higher sulfonated subsidiaries, ≤ 5.0% 4-Aminoazobenzene, not more than 50 ppb. 4-Aminobiphenyl, not more than 15 ppb. Aniline, not more than 250 ppb. Azobenzene, not more than 200 ppb. Benzidine, not more than 1 ppb. 1,3-Diphenyltriazene, not more than 40 ppb. 1-(Phenylazo)-2-naphthalenol, not more than 10 ppm. Total color, not less than 87.0%
D&C Yellow No. 7	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of water and chlorides and sulfates not more than 6%. Matter insoluble in alkaline water, not more than 0.5%. Resorcinol, not more than 0.5%. Phthalic acid, not more than 0.5%. 2-2,4-(Dihydroxybenzoyl) benzoic acid, not more than 0.5%.
D&C Yellow No. 8	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of water and chlorides and sulfates not more than 15%. Matter insoluble in alkaline water, not more than 0.3%. Resorcinol, not more than 0.5%. Phthalic acid, not more than 1%. 2-(2,4-Dihydroxybenzoyl) benzoic acid, not more than 0.5%.
D&C Yellow No. 10	Lead not more than 20 ppm Arsenic not more than 3 ppm Mercury not more than 1 ppm	Sum of water and chlorides and sulfates not more than 15%. Matter insoluble in both water and chloroform, not more than 0.2%. Total sulfonated quinaldines, sodium salts, not more than 0.2%. 2-(2-Quinoliny)-1H-indene-1,3 (2H)-dione, not more than 4 ppm. Sodium salts sum of monosulfonates of 2-(2-quinoliny)-1H-indene-1,3 (2H)-dione, ≥ 75 %. Sodium saltsum of disulfonates of 2-(2-quinoliny)-1H-indene-1,3 (2H)-dione, ≤ 15 %. 2-(2,3-Dihydro-1,3-dioxo-1H-indene-2-yl)-6, 8-quinolinedisulfonic acid, disodium salt, ≤ 3%. Diethyl ether soluble matter other than that specified, not more than 2 ppm using added 2-(2-quinoliny)-1H-indene-1,3 (2H)-dione for calibration.

D&C Yellow No. 11	Lead not more than 20 ppm	Volatile matter (at 275 deg.F), not more than 1%.
	Arsenic not more than 3 ppm	Ethyl alcohol-insoluble matter, not more than 0.4%.
	Mercury not more than 1 ppm	Phthalic acid, not more than 0.3%
		Quinaldine, not more than 0.2%.
		Subsidiary colors, not more than 5%.

Source: FDA³

Dermal Absorption

According to the Children's Environmental Health Project, dermal absorption is proportional to the concentration of the substance and the surface area to which the substance is applied. Dermal absorption rates vary person to person and are affected by variables such as skin thickness, occlusions, and the composition of the substance. Composition refers to if the substance is lipid-soluble. If it is, it will be more easily absorbed into the skin.⁴

This is such an important point because this means we have to be as vigilant about what we put on our skin as we are about what we are eating. In addition, most of the cosmetic colorings actually allowed for higher concentrations of heavy metals and if the dermal absorption rate varies person to person, the amount of toxic substances could affect some individuals more so than others. Something as innocent as washing your hands with soap could be exposing you to more than you bargained for and identifying alternatives needs to be a priority.

There are several studies on PubMed that considered percutaneous absorption of lead. One study looked at inorganic lead compounds and the conclusion of the study was that significant amounts of inorganic lead compounds can be absorbed through the skin and protection should be used.⁵ Another study looked at inorganic lead compounds and how effective skin cleansers were at removing lead from the skin. Their results showed it is necessary to prevent skin contamination from occurring because a short contact can increase skin content and penetration even if quickly followed by washing.⁶ Furthermore, emedicine reports that transdermal absorption for alkyl lead can be substantial.

Mercurial ointments were used as a treatment for syphilis before the discovery of penicillin. The ointments were applied directly to the thinnest areas of the skin such as the groin and the bends of the elbows and knees. Some scientists believed that the dermal absorption of the ointment was quite low and the patients were actually receiving benefit from inhaling the mercury vapor. A study was performed where the ointment was rubbed in and any excess was washed off the skin, eliminating any source of mercury vapor. 75% of the participants of the study experienced salivation; one of the known effects of mercury proving dermal absorption played a key role.⁷

Per the Department of Health and Human Services, dermal absorption of arsenic is low, however, it is readily absorbed if inhaled or ingested. Many wood based playground structures were removed fearing children would touch the arsenic treated wood and put their hands in their mouths.

Colors and Mental Health

As mentioned previously, Dr. Feingold identified a link between food coloring and hyperactivity. He also noticed a marked increase in the ADD/ADHD classification after the mass introduction of food colorings into our society.

A brochure available in my pediatrician's office by McNeil Consumer & Specialty Pharmaceuticals indicates that lead exposure can lead to ADHD, yet they discredit the idea that food/cosmetic colors have any role in affecting children's behavior⁸. If lead has been implicated in ADHD and colorings have lead in them, then removal from the diet and environment are crucial. The Journal of Developmental & Behavioral Pediatrics published information regarding 15 trials with 219 participants – all were double-blind cross-over trials. Just by eliminating artificial food colorings from their diet, children's behavior improved significantly. Furthermore, eliminating food colorings from the diet was one-third to one-half of the size of improvements typically seen with ADHD medication therapy.⁹

Even if one elects to use medication, heavy metal toxicity screenings need to be prescribed prior to psychoactive drugs because most of these drugs contain colors which can lead to further toxicity. The following table provides the coloring present in commonly prescribed ADHD medications:

Color Content in ADHD Medications

Ritalin 5mg and 20 mg	D&C Yellow No. 10
Ritalin 10 mg	FD&C Green No.3
Strattera	FD&C Blue No. 2, synthetic yellow iron oxide and edible black ink.
Dexedrine	FD&C Yellow No. 5 and FD&C Yellow No. 6

Source: rxlist.com¹⁰

This means that children taking these drugs are being exposed to lead, arsenic, and mercury. This also indicates that these children in particular need to be extremely careful with whatever medications they may take – acetaminophen, ibuprofen, antibiotics, etc., to ensure that alternative products that do not contain food dyes are selected. Amoxicillin¹¹ and Cefzil¹² for example contain FD&C approved red dyes as well as aspartame. We as parents can check food labels, but we rely on our physicians to select our medicines and the bottles provided by the pharmacist do not list the ingredients. Colloidal silver, homeopathy, and supplements may provide a safer alternative.

Several studies also point to the link between lead and ADHD. One of the most recent was published in the Journal of Environmental Health Perspectives.¹³ According to the Journal, children with blood lead levels of more than 2 micrograms per deciliter were four times more likely to be diagnosed with ADHD than children with levels below .8 microgram per deciliter. The government's acceptable blood lead level is 10 micrograms per deciliter. The study estimates that more than 5 million 4-15 year olds in the U.S. have levels higher than 2 micrograms per deciliter.

Another study done by the National Academy of Sciences in 2000 stated that roughly 3% of all developmental and neurological disorders in the U.S. are caused by toxic chemicals

and other environmental factors. The same study showed that environmental triggers along with a genetic predisposition may cause approximately 25% of developmental and neurological deficits. The Academy also acknowledged that in this study they were only referring to well recognized and clinically diagnosed mental and physical disabilities – therefore the 25% estimate may in fact be higher.¹⁴

What is Your Child being exposed to on a Daily Basis?

A Day in the Life of a Child

Most parents I speak to are completely unaware of the color content of their food, cosmetic products, and medicines. Some that are aware are shocked to find out it doesn't come from natural substances. The following tables offer color information regarding some popular children foods, cosmetics, and over-the-counter supplementation/medicines.

Food Items

Gatorade Fruit Punch	red #40
Plain M&Ms	Red 40 Lake, Blue 2 Lake, Yellow 5, Yellow 6, Blue 1 Lake, Red 40, Blue 1
Bakery mini chocolate muffin	FD&C Red 40
Kraft Macaroni & cheese	Yellow 5, Yellow 6
Eggo Waffles	Yellow #5, Yellow #6
Fruit Loops	Red No. 40, Blue No. 2, Yellow No. 6, Blue No. 1
Dannon Sprinkl'ins Yogurt ¹⁵	Yellow 6, Yellow 5, Red 40, Blue 1, Yellow 6 Lake, Red 3, Red 40 Lake, Yellow 5 Lake, Blue 2 Lake, Blue 1, Blue 1 Lake, Blue 2
Nutrigrain Blueberry bars	Red 40, Blue 1
Strawberry Pop tarts	Red 40, Yellow 6, Blue 1

Cosmetic Items

Bathtime Colorblast Tablets	FD&C Yellow #5, FD&C Blue #1, D&C Red #33
Johnson Baby Shampoo	D&C Yellow #10, D&C Orange #4
Johnson Baby Lotion	D&C Red 33
Pampers hand soap	Yellow 5, Green 5, Orange 4
Dora Foam Soap	May contain FD&C Blue 1, FD&C Red 40, FD&C Yellow 5
Sesame Street Foam Soap	FD&C # 33
Disney Chapstick	D&C Red No. , FD&C Blue 1 alum lk
Crest Kids Sparkle Paste	FD&C Blue #1

OTC Supplementation/Medicines

Flintstones Vitamins (also contains aspartame)	FD&C Red #40 Al Lake, FD&C Yellow 6 Al Lake FD&C Blue #2
Tylenol Plus Cold Infant Drops	Red #33 and Red 40
Delsym Cough Medicine	FD&C Yellow 6

Cumulative Effects of Exposure?

What are the cumulative effects of food and cosmetic colorings to us as humans and more importantly to our children? According to Dr. Gary Gordon¹⁶, each time a manufacturer prepares a batch of dye for use in its products; it has to submit a sample from that batch to the FDA for certification. Only the FDA can certify colors as safe - no one else has that authority. I was unable to find any studies indicating overall exposure or estimated daily exposure to these metals. I was also unable to find any studies on the mixing of food colorings or the total amount of lead, mercury, arsenic content for products that use a combination of colors. This is concerning.

Colors in your Cleaners

Cleaning products present an interesting challenge since manufacturers do not have to identify the ingredients of their products on the labels. Material Safety Data Sheets (MSDS) are available for consumers to view via most companies' web sites. However,

these MSDS require manufacturers to provide information regarding established exposure limits - they do not provide an ingredient list and are protected by patent laws.

The Effects of Lead, Mercury, and Arsenic

Lead

We have all heard that lead is associated with lower I.Q., but did you know it could also be responsible for some cavities? According to a study published in the *Journal of the American Medical Association* 281(June 23/30):2294, where data was analyzed from 24,901 children, a correlation between lead and cavities were established. Most of the children participating in the study, had blood-lead levels of only a few micrograms of lead per deciliter, well below the federal guideline for blood-lead concentrations is 10 mcg per deciliter. For children ages 5 to 17, an increased burden of 5 mcg per deciliter of blood corresponded to an 80 percent increase in cavities. The researchers estimate that cavities of 2.7 million U.S. children result from lead, about 10 percent of all cases in that age group. The researchers speculated that either the lead stunts development of the glands that produce saliva (which protects teeth from harmful acid and bacteria) or whether lead might hinder enamel growth.¹⁷

The American Academy of Child and Adolescent Psychiatry, estimates one out of every six children in the United States has blood lead levels in the toxic range.¹⁸

Lead exposure has been linked to developmental delays, peripheral neuropathy, altered thyroid hormone, and reduced fertility. In elderly adults levels over 4 mcgs can have neurobehavioral effects.

Mercury

So what do you do if you get a cavity? Well some dentists will fill your teeth with amalgams that contain mercury. Mercury has been implicated in autism, ADHD, learning disabilities, endocrine problems, allergies, asthma, rheumatoid arthritis, and a host of other disorders. According to the FDA, "The toxicity of mercury compounds is extensively documented in scientific literature. It is well known that mercury compounds are readily absorbed through the unbroken skin as well as through the lungs by inhalation and by intestinal absorption after ingestion. Mercury is absorbed from topical application and is accumulated in the body, giving rise to numerous adverse effects. ... Recently it has also been determined that microorganisms in the environment can convert various forms of mercury into highly toxic methyl mercury which has been found in the food supply and is now considered to be a serious environmental problem."¹⁹

Common Dreams newswire reported in 2004 that EPA scientists using data collected by the Centers for Disease Control estimated that one in six pregnant women has enough mercury in her blood to pose a risk of brain damage to her developing child.²⁰

Lower levels of mercury exposure can lead to symptoms of fever, insomnia, rapidly changing moods and tremors.

Arsenic

Arsenic poisoning has been associated with respiratory, neurological, developmental, and cardiovascular issues. It has also been associated with cancer. In fact, an increased risk of skin cancer in humans is associated with chronic exposure to inorganic arsenic in medication, contaminated water, and the workplace.²¹

Arsenic is present in food such as meat, fish, and poultry and according to the Department of Health and Human Services, accounts for 80% of our dietary intake (although fish arsenic has a low toxicity in humans and is excreted rapidly in our urine). Fungicides, herbicides, insecticides, paints, and water are other sources of exposure.

An intellectual function study which included 201 children under the age of 10 concluded that as little as .0017 mg per day affected children's performance in switching attention task. When the exposure increased to .0034 mg per day, the children showed decreased performance in both switching attention tasks as well as in tests which measured memory.²²

What Can We Do?

The first step is to remove colors from your environment. This can be difficult since colors are pervasive, but there are alternatives. For instance, if you need food coloring, health food stores sell colors made from food - turmeric, blueberry, beets, etc. These can be used to make play dough as well as to color foods. Health food stores also make available muffins, toothpastes, snacks, chocolates, drinks, and OTC medications that do not contain colors. Whole Foods and Trader Joe's have policies to not carry anything with artificial food coloring.

Cooking and eating as many meals as possible at home is also a step in the right direction. You can control what you put in your food.

If you need to obtain medication and are not sure if it contains colors, you can check online at www.rxlist.com. If your medication is made with colors, contact a compounding pharmacy to see if they can compound without all of the colors. A list of compounding pharmacies can be found at www.iacprx.org.

¹ Pressinger, R. Chemical Food Additive Exposure During Pregnancy Links to Learning Disabilities, ADD and Behavior Disorders, University of South Florida Special Education Department (online). Available at: <http://www.chem-tox.com/pregnancy/artificial.htm>. Accessed October 14, 2007.

² Food and Drug Administration (online). Available at: www.cfsan.fda.gov/~dms/opa-col2.html#table1A. Accessed June 10, 2005 and October 14, 2006.

³ Food and Drug Administration (online). Available at: www.cfsan.fda.gov/~dms/opa-col2.html#table1A. Accessed June 10, 2005 and October 14, 2006.

⁴ Canadian Association of Physicians for the Environment (online). Available at: www.cape.ca/children/derm.html. Accessed September 13, 2006.

⁵ Sun CC, et al. Percutaneous absorption of inorganic lead compounds. *American Industrial Hygiene Association* 2002 Sep-Oct; 63(5):641-6.

⁶ Filon, et al. Skin absorption of inorganic lead (PbO) and the effect of skin cleansers. *Journal of Occupational and Environmental Medicine*. 2006 Jul;48(7):692-9.

⁷ Scheindlin, Transdermal Drug Delivery: Past, Present, Future. *Molecular Interventions* (online). Dec. 2004, Vol.4 Iss. 6. Available at: <http://molinterv.aspetjournals.org/cgi/content/full/4/6/308>. Accessed: August 1, 2006.

-
- ⁸ McNeil Consumer & Specialty Pharmaceuticals, ADHD: Answers from the Experts, Science Made Simple. Brochure.
- ⁹ Schab, D.W., Trinh, N.H. Do Artificial Food Colors Promote Hyperactivity in Children with Hyperactive syndromes? *Journal of Developmental & Behavioral Pediatric* (2004)s. 25(6) 423-434 (online). Available at: http://www.fabresearch.org/view_item.aspx?item_id=789. Accessed October 27, 2006.
- ¹⁰ Available at: www.rxlist.com/cgi/generic/methphen.htm Accessed on November 8, 2006.
- ¹¹ Available at: <http://www.rxlist.com/cgi/generic/amox.htm> Accessed on November 8, 2006.
- ¹² Available at: <http://www.rxlist.com/cgi/generic/cefprozi.htm> Accessed on November 8, 2006.
- ¹³ Braune, J., et al. Exposure to Environmental Toxicants and Attention Deficit Hyperactivity in Children. *Environmental Health Perspectives* (online). 2006 Dec. Volume 114, Number 12. Available at: <http://www.ehponline.org/members/2006/9478/9478.pdf> Accessed on October 14, 2006
- ¹⁴ National Environmental Trust (online) Available at: <http://www.net.org/health/neighborhood/cehfuture/intro.vtml> Accessed on June 24, 2006.
- ¹⁵ Food Facts (online). Available at: http://www.foodfacts.com/members/item_info.cfm?id=18211 Accessed on November 2, 2006
- ¹⁶ Gordon, G. Gordon Research Institute (online). Available at: http://www.gordonresearch.com/answers/lead_in_cosmetics_an_urban_legend.html Accessed on September 30, 2006.
- ¹⁷ Carpenter S. Lead and Bad Diet Give a Kick in the Teeth. *Science News Online*. Available at: http://www.sciencenews.org/pages/sn_arc99/6_26_99/fob3.htm Accessed on August 27, 2006.
- ¹⁸ American Academy of Child and Adolescent Psychiatry. Facts for Families: Lead Exposure, 1997 (online). Available at: <http://www.healing-arts.org/children/ADHD/lead.htm> Accessed June 1, 2006.
- ¹⁹ Food and Drug Administration (online). Available at: www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=700&showFR=1&subpartNo=21:7.0.1.2.10.2 Accessed: August 10, 2005 and September 10, 2006.
- ²⁰ Bender, M. FDA Not Protecting Children From Mercury in Fish, Say Advocates, According to New Research. *Common Dreams Newscenter* (online). <http://www.commondreams.org/news2004/0205-14.htm> Accessed: October 3, 2007
- ²¹ Case Study in Environmental Medicine. Agency for Toxic Substances and Disease Registry (online). Available at: http://www.atsdr.cdc.gov/HEC/CSEM/arsenic/physiologic_effects.html Accessed on November 4, 2007.
- ²² Wasserman, G. Water Arsenic Exposure and Children's Intellectual Function in Araihasar, Bangladesh. *Environmental Health Perspective*. Available at: <http://www.ehponline.org/members/2004/6964/6964.pdf> Accessed on October 19, 2006.