

**Biomonitoring California  
Priority Chemicals  
February 2011**

The following is a list of priority chemicals for Biomonitoring California.<sup>a</sup> The Scientific Guidance Panel (SGP) recommends priority chemicals from the designated chemical list. Targets for measurement in biomonitoring studies could include the parent chemical, metabolites and other chemical products formed in the body or the environment (e.g., hemoglobin adduct; environmental degradation product). The approach for biomonitoring a chemical may change as methods development proceeds. The parent chemical is provided in the list below and, for some parent chemicals, other targets for biomonitoring are shown indented underneath. Biomonitoring California determines the chemicals that are actually biomonitored and the appropriate targets for measurement.

**Brominated and Chlorinated Organic Compounds used as Flame Retardants<sup>1</sup>**

2,2-Bis(bromomethyl)-1,3-propanediol  
2,2-Bis(chloromethyl)trimethylene bis[bis(2-chloroethyl)phosphate]  
Bis(2-ethyl-1-hexyl)tetrabromophthalate (TBPH)  
Bis(hexachlorocyclopentadieno)cyclooctane (Dechlorane Plus)  
1,2-Bis(2,4,6-tribromophenoxy)ethane (BTBPE)  
1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane  
2,3-Dibromopropyl-2,4,6-tribromophenyl ether (DPTE)  
2-Ethyl-1-hexyl-2,3,4,5-tetrabromobenzoate (TBB)  
Chlorendic acid  
Decabromodiphenylethane (DBDPE)  
Hexabromobenzene  
2,2',4,4',5,5'-Hexabromobiphenyl (BB 153)  
Hexabromocyclododecane (HBCD)  
Hexachlorocyclopentadienyl-dibromocyclooctane  
N,N'-Ethylenebis(tetrabromophthalimide)  
Pentabromoethylbenzene  
Pentabromotoluene  
Short-chain chlorinated paraffins  
Tetrabromobisphenol A (TBBPA)  
Tetrabromobisphenol A bis(2,3-dibromopropyl) ether  
Tetrabromobisphenol A bis(2-hydroxyethyl) ether  
Tetrabromophthalic anhydride  
Tetrakis(2-chloroethyl)dichloroisopentyl diphosphate  
2,4,6-Tribromophenol  
Tris(2-chloroethyl)phosphate (TCEP)  
Tris(1-chloro-2-propyl)phosphate (TCPP)  
Tris(1,3-dichloro-2-propyl)phosphate (TDCPP)  
Tris(2,3-dichloro-1-propyl)phosphate

**Polybrominated diphenyl ethers (PBDEs)**

2,2',4-Tribromodiphenyl ether (BDE 17)  
2,4,4'-Tribromodiphenyl ether (BDE 28)  
2,2',4,4'-Tetrabromodiphenyl ether (BDE 47)

2,3',4,4'-Tetrabromodiphenyl ether (BDE 66)  
2,2',3,4,4'-Pentabromodiphenyl ether (BDE 85)  
2,2',4,4',5-Pentabromodiphenyl ether (BDE 99)  
2,2',4,4',6-Pentabromodiphenyl ether (BDE 100)  
2,2',4,4',5,5'-Hexabromodiphenyl ether (BDE 153)  
2,2',4,4',5,6'-Hexabromodiphenyl ether (BDE 154)  
2,2',3,4,4',5',6-Heptabromodiphenyl ether (BDE 183)  
2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether (BDE 209)

**Cyclosiloxanes<sup>1</sup>**

Decamethylcyclopentasiloxane (D5)  
Dodecamethylcyclohexasiloxane (D6)  
Octamethylcyclotetrasiloxane (D4)

**Diesel Exhaust<sup>2</sup>**

**Environmental Phenols<sup>3</sup>**

Bisphenol A  
Triclosan

**Parabens<sup>3</sup>**

Butylparaben<sup>4</sup>  
Ethylparaben  
Methylparaben  
n-Propylparaben

**Metals<sup>3</sup>**

Arsenic  
    Arsenic (V) acid  
    Arsenobetaine  
    Arsenocholine  
    Arsenous (III) acid  
    Dimethylarsinic acid  
    Monomethylarsonic acid  
    Trimethylarsine oxide  
Cadmium

a. California Environmental Contaminant Biomonitoring Program, codified at Health and Safety Code section 105440 et seq.

Lead  
Mercury

**Perchlorate**

**Perfluorochemicals<sup>3</sup>**

2-(N-Ethylperfluorooctanesulfonamido) acetic acid  
2-(N-Methylperfluorooctanesulfonamido) acetic acid  
Perfluorobutane sulfonic acid  
Perfluorodecanoic acid  
Perfluorododecanoic acid  
Perfluoroheptanoic acid  
Perfluorohexane sulfonic acid  
Perfluorononanoic acid  
Perfluorooctane sulfonamide  
Perfluorooctane sulfonic acid (PFOS)  
Perfluorooctanoic acid (PFOA)  
Perfluoroundecanoic acid

**Pesticides<sup>3, 5</sup>**

**Herbicides<sup>3</sup>**

2,4-Dichlorophenoxyacetic acid (2,4-D), salts and esters  
2,4-Dichlorophenoxyacetic acid  
2,4-Dichlorophenol

**Organochlorine Pesticides<sup>3</sup>**

Dichlorodiphenyltrichloroethane (DDT) (including p,p'-DDT and o,p'-DDT)  
p,p'-Dichlorodiphenyldichloroethene (DDE)

**Organophosphorus Insecticides<sup>3</sup>**

Acephate  
Azinphos methyl  
Dimethyldithiophosphate  
Dimethylphosphate  
Dimethylthiophosphate  
Chlorethoxyphos  
Diethylphosphate  
Diethylthiophosphate  
Chlorpyrifos  
Diethylphosphate  
Diethylthiophosphate  
3,5,6-Trichloro-2-pyridinol  
Chlorpyrifos methyl  
Dimethylphosphate  
Dimethylthiophosphate  
3,5,6-Trichloro-2-pyridinol  
Coumaphos  
3-Chloro-7-hydroxy-4-methyl-2H-chromen-2-one/ol

Diethylphosphate  
Diethylthiophosphate  
Diazinon  
Diethylphosphate  
Diethylthiophosphate  
2-Isopropyl-4-methyl-6-hydroxypyrimidine  
Dichlorvos (DDVP)  
Dimethylphosphate  
Dicrotophos  
Dimethylphosphate  
Dimethoate  
Dimethyldithiophosphate  
Dimethylphosphate  
Dimethylthiophosphate  
Disulfoton  
Diethyldithiophosphate  
Diethylphosphate  
Diethylthiophosphate  
Ethion  
Diethyldithiophosphate  
Diethylphosphate  
Diethylthiophosphate  
Fenitrothion  
Dimethylphosphate  
Dimethylthiophosphate  
Fenthion  
Dimethylphosphate  
Dimethylthiophosphate  
Isazophos-methyl  
5-Chloro-1,2-dihydro-1-isopropyl-[3H]-1,2,4-triazol-3-one  
Dimethylphosphate  
Dimethylthiophosphate  
Malathion  
Dimethyldithiophosphate  
Dimethylphosphate  
Dimethylthiophosphate  
Malathion dicarboxylic acid  
Methamidophos  
Methidathion  
Dimethyldithiophosphate  
Dimethylphosphate  
Dimethylthiophosphate  
Methyl parathion  
Dimethylphosphate  
Dimethylthiophosphate  
p-Nitrophenol  
Naled  
Dimethylphosphate  
Oxydemeton-methyl  
Dimethylphosphate  
Dimethylthiophosphate  
Parathion (Ethyl parathion)  
Diethylphosphate  
Diethylthiophosphate  
p-Nitrophenol

Phorate  
 Diethyldithiophosphate  
 Diethylphosphate  
 Diethylthiophosphate  
 Phosmet (Imidan)  
 Dimethyldithiophosphate  
 Dimethylphosphate  
 Dimethylthiophosphate  
 Pirimiphos-methyl  
 2-(Diethylamino)-6-methylpyrimidin-4-ol/one  
 Dimethylphosphate  
 Dimethylthiophosphate  
 Sulfotepp  
 Diethylphosphate  
 Diethylthiophosphate  
 Temephos  
 Dimethylphosphate  
 Dimethylthiophosphate  
 Terbufos  
 Diethyldithiophosphate  
 Diethylphosphate  
 Diethylthiophosphate  
 Tetrachlorvinphos  
 Dimethylphosphate

**Pyrethroid Pesticides<sup>3</sup>**

Allethrin  
*cis/trans*-Dimethylvinylcyclopropane carboxylic diacid  
 Cyfluthrin  
*cis*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
*trans*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
 4-Fluoro-3-phenoxybenzoic acid  
 Cyhalothrin (including *lambda*- and *gamma*-)  
 3-Phenoxybenzoic acid  
 Cypermethrin (including *cis*- and *trans*-)  
*cis*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
*trans*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
 3-Phenoxybenzoic acid  
 Deltamethrin  
*cis*-3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid  
 3-Phenoxybenzoic acid  
 Fenpropathrin  
 3-Phenoxybenzoic acid  
 Permethrin (including *cis*- and *trans*-)  
*cis*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
*trans*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
 3-Phenoxybenzoic acid

Pyrethrin 1  
*cis/trans*-Dimethylvinylcyclopropane carboxylic diacid  
 Resmethrin  
*cis/trans*-Dimethylvinylcyclopropane carboxylic diacid  
 Tralomethrin  
 3-Phenoxybenzoic acid

**Other Pesticides**

1,4-Dichlorobenzene (*p*-Dichlorobenzene)  
 2,5 Dichlorophenol

**Phthalates<sup>3</sup>**

Benzylbutyl phthalate (BzBP)  
 Mono-benzyl phthalate  
 Dibutyl phthalate (DBP)<sup>6</sup>  
 Mono-*n*-butyl phthalate  
 Mono-isobutyl phthalate  
 Dicyclohexyl phthalate (DCHP)  
 Mono-cyclohexyl phthalate  
 Diethyl phthalate (DEP)  
 Mono-ethyl phthalate  
 Di-2-ethylhexyl phthalate (DEHP)  
 Mono-(2-ethyl-5-carboxypentyl) phthalate  
 Mono-2-ethylhexyl phthalate  
 Mono-(2-ethyl-5-hydroxyhexyl) phthalate  
 Mono-(2-ethyl-5-oxohexyl) phthalate  
 Di-isodecyl phthalate (DiDP)  
 Mono-(carboxynonyl) phthalate  
 Di-isononyl phthalate (DiNP)  
 Mono(carboxyisononyl) phthalate  
 Mono(hydroxyisononyl) phthalate  
 Mono-isononyl phthalate  
 Mono(oxoisononyl) phthalate  
 Dimethyl phthalate (DMP)  
 Mono-methyl phthalate  
 Di-*n*-octyl phthalate (DOP)  
 Mono-(3-carboxypropyl) phthalate  
 Mono-*n*-octyl phthalate

**Polychlorinated Biphenyls (PCBs),  
Dioxin-Like<sup>3</sup>**

**Coplanar PCBs<sup>3</sup>**

3,4,4',5-Tetrachlorobiphenyl (PCB 81)  
 3,3',4,4',5-Pentachlorobiphenyl (PCB 126)  
 3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)

**Mono-ortho-Substituted PCBs<sup>3</sup>**

2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)  
 2,3',4,4',5-Pentachlorobiphenyl (PCB 118)  
 2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)

2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)  
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)  
2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)

**Polychlorinated Biphenyls (PCBs),  
Non-Dioxin-Like<sup>3</sup>**

2,2',5-Trichlorobiphenyl (PCB 18)  
2,4,4'-Trichlorobiphenyl (PCB 28)  
2,2',3,5'-Tetrachlorobiphenyl (PCB 44)  
2,2',4,5'-Tetrachlorobiphenyl (PCB 49)  
2,2',5,5'-Tetrachlorobiphenyl (PCB 52)  
2,3',4,4'-Tetrachlorobiphenyl (PCB 66)  
2,4,4',5-Tetrachlorobiphenyl (PCB 74)  
2,2',3,4,5'-Pentachlorobiphenyl (PCB 87)  
2,2',4,4',5-Pentachlorobiphenyl (PCB 99)  
2,2',4,5,5'-Pentachlorobiphenyl (PCB 101)  
2,3,3',4',6-Pentachlorobiphenyl (PCB 110)  
2,2',3,3',4,4'-Hexachlorobiphenyl (PCB 128)  
2,2',3,4,4',5' and 2,3,3',4,4',6-Hexachlorobiphenyl  
(PCB 138 & 158)  
2,2',3,4',5,5'-Hexachlorobiphenyl (PCB 146)  
2,2',3,4',5',6'-Hexachlorobiphenyl (PCB 149)  
2,2',3,5,5',6-Hexachlorobiphenyl (PCB 151)  
2,2',4,4',5,5'-Hexachlorobiphenyl (PCB 153)  
2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB 170)  
2,2',3,3',4,5,5'-Heptachlorobiphenyl (PCB 172)  
2,2',3,3',4,5',6'-Heptachlorobiphenyl (PCB 177)  
2,2',3,3',5,5',6-Heptachlorobiphenyl (PCB 178)  
2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180)  
2,2',3,4,4',5',6-Heptachlorobiphenyl (PCB 183)  
2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB 187)  
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (PCB 194)  
2,2',3,3',4,4',5,6-Octachlorobiphenyl (PCB 195)  
2,2',3,3',4,4',5,6' and 2,2',3,4,4',5,5',6-Octa-  
chlorobiphenyl (PCB 196 & 203)  
2,2',3,3',4,5,5',6-Octachlorobiphenyl (PCB 199)  
2,2',3,3',4,4',5,5',6'-Nonachlorobiphenyl (PCB 206)  
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (PCB  
209)

**Polycyclic Aromatic Hydrocarbons  
(PAHs)<sup>3,7</sup>**

3-Hydroxybenzo[a]pyrene  
6-Hydroxychrysene  
3-Hydroxyphenanthrene

**Tobacco Smoke**

Nicotine  
Cotinine

**Notes**

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<sup>1</sup> All members of the chemical class are priority chemicals, including, but not limited to, the chemicals listed.

<sup>2</sup> Diesel exhaust is a complex mixture that contains many components, one or more of which may be useful as an indicator for biomonitoring.

<sup>3</sup> All members of the chemical class are not priority chemicals; only the specific chemicals listed are priority chemicals.

<sup>4</sup> Includes n-butylparaben and isobutylparaben.

<sup>5</sup> Fungicides, herbicides, and insecticides are grouped under the general heading of "Pesticides."

<sup>6</sup> Includes di-n-butyl phthalate and di-isobutyl phthalate.

<sup>7</sup> The SGP recommended the three hydroxy-PAHs listed as priority chemicals. These three hydroxy-PAHs are metabolites of benzo[a]pyrene, chrysene and phenanthrene, respectively.