

**Biomonitoring California
Priority Chemicals
May 2013**

The following is a list of priority chemicals for Biomonitoring California.^a The Scientific Guidance Panel (SGP) recommends priority chemicals from the designated chemicals 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. For some of the parent chemicals listed below, metabolites or other targets for measurement are shown indented underneath. Chemicals are grouped into categories (like “metals” and “pesticides”); some are included in more than one category. Biomonitoring California determines the chemicals that are actually biomonitored and the appropriate targets for measurement.

Brominated and Chlorinated Organic Compounds used as Flame Retardants¹

Allyl 2,4,6-tribromophenyl ether (ATE)
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)
2-Bromoallyl-2,4,6-tribromophenyl ether (BATE)
Chlorendic acid
Decabromodiphenylethane (DBDPE)
1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane (TBECH)
2,4-Dibromophenol
2,3-Dibromopropyl-2,4,6-tribromophenyl ether (DPTE)
2-Ethyl-1-hexyl-2,3,4,5-tetrabromobenzoate (TBB)
N,N'-Ethylenebis(tetrabromophthalimide)
Hexabromobenzene (HBB)
2,2',4,4',5,5'-Hexabromobiphenyl (BB 153)
Hexabromocyclododecane (HBCD)
Hexachlorocyclopentadienyl-dibromocyclooctane
Isobutoxypentabromocyclododecanes (iBPBCDs)
Octabromotrimethylphenylindane (OBIND)
Pentabromoethylbenzene (PBEB)
Pentabromophenol (PBP)
Pentabromotoluene (PBT)
Short-chain chlorinated paraffins
Tetrabromobisphenol A (TBBPA)
Tetrabromobisphenol A bis(2,3-dibromopropyl) ether
Tetrabromobisphenol A bis(2-hydroxyethyl) ether (TBBPA-DBPE)
Tetrabromophthalic anhydride
2,3,5,6-Tetrabromo-*p*-xylene
2,4,6-Tribromophenol

Tris(2-chloroethyl)phosphate (TCEP)
Tris(1-chloro-2-propyl)phosphate (TCPP)
Tris(2,3-dibromopropyl) isocyanurate
Tris(2,3-dibromopropyl)phosphate (TDBPP)
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',5,6'-Octabromodiphenyl ether (BDE 196)
2,2',3,3',4,4',6,6'-Octabromodiphenyl ether (BDE 197)
2,2',3,3',4,5',6,6'-Octabromodiphenyl ether (BDE 201)
2,2',3,3',5,5',6,6'-Octabromodiphenyl ether (BDE 202)
2,2',3,4,4',5,5',6-Octabromodiphenyl ether (BDE 203)
2,2',3,3',4,4',5,5',6-Nonabromodiphenyl ether (BDE 206)
2,2',3,3',4,4',5,6,6'-Nonabromodiphenyl ether (BDE 207)
2,2',3,3',4,5,5',6,6'-Nonabromodiphenyl ether (BDE 208)
2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether (BDE 209)

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

Hydroxy-PBDEs (Metabolites of PBDEs)

4'-Hydroxy-BDE 17
2'-Hydroxy-BDE 68
5-Hydroxy-BDE 47
6-Hydroxy-BDE 47
4'-Hydroxy-BDE 49
5'-Hydroxy-BDE 99
5'-Hydroxy-BDE 100
4'-Hydroxy-BDE 101
4'-Hydroxy-BDE 103

Cyclosiloxanes¹

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

Diesel Exhaust²

Diglycidyl Ethers of *p,p'*-Bisphenols¹

Bisphenol A diglycidyl ether (BADGE)
Bisphenol F diglycidyl ether (BFDGE)

Environmental Phenols³

Triclosan

***p,p'*-Bisphenols¹**

Bisphenol A (BPA)
Bisphenol AF (BPAF)
Bisphenol B (BPB)
Bisphenol F (BPF)
Bisphenol S (BPS)
4,4'-Sulfonylbis[2-(2-propen-1-yl)phenol] (TGSA)

Brominated phenols^{3,4}

2,4-Dibromophenol
Pentabromophenol (PBP)
Tetrabromobisphenol-A (TBBPA)
2,4,6-Tribromophenol

Chlorinated phenols^{3,5}

2,4-Dichlorophenol
2,5-Dichlorophenol

Parabens³

Butylparaben⁶
Ethylparaben
Methylparaben
n-Propylparaben

Metals³

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

Non-Halogenated Aromatic Phosphates¹

Bisphenol A bis(diphenyl phosphate)
Butylated triphenyl phosphate
t-Butylphenyl diphenyl phosphate
2-Ethylhexyl diphenyl phosphate
Isodecyl diphenyl phosphate
Isopropylated triphenyl phosphate
Resorcinol bis(diphenyl phosphate)
Tricresyl phosphate
Triphenyl phosphate

Perchlorate

Perfluorochemicals³

2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid
2-(N-Methyl-perfluorooctane sulfonamido) 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^{3,7}

Herbicides³

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

Organochlorine Pesticides³

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

Organophosphate Insecticides³

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 Pesticides³

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

Phthalates³

Benzylbutyl phthalate (BzBP)
Mono-benzyl phthalate

Dibutyl phthalate (DBP)⁸
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-(carboxyoctyl) 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**³

Coplanar PCBs³

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 PCBs³

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**³

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'-Hexachlorobiphenyl (PCB 138)
2,3,3',4,4',6-Hexachlorobiphenyl (PCB 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'-Octachlorobiphenyl (PCB 196)
2,2',3,4,4',5,5',6-Octachlorobiphenyl (PCB 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)

Tobacco Smoke

Nicotine
Cotinine
NNK (4-[Methylnitrosamino]-1-[3-pyridyl]-1-butanone)
NNAL (4-[methylnitrosamino]-1-(3-pyridyl)-1-butanol)

Polychlorinated Biphenyls (PCBs)

Hydroxy-PCBs (Metabolites of PCBs)

4-Hydroxy-PCB 107
4-Hydroxy-PCB 120
4'-Hydroxy-PCB 130
3'-Hydroxy-PCB 138
4-Hydroxy-PCB 146
3-Hydroxy-PCB 153
4'-Hydroxy-PCB 172
3'-Hydroxy-PCB 180
4-Hydroxy-PCB 187
4-Hydroxy-PCB 187
4'-Hydroxy-PCB 193

Polycyclic Aromatic Hydrocarbons (PAHs)^{3,9}

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

Notes

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

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

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

⁴ These brominated phenols are part of the chemical group “brominated and chlorinated organic compounds used as flame retardants”, which are listed as priority chemicals. The brominated phenols are also included in the category “environmental phenols” because the laboratory measures them with other environmental phenols.

⁵ 2,4-Dichlorophenol and 2,5-dichlorophenol are metabolites of certain pesticides, which are listed as priority chemicals. These chlorophenols are also included in the category “environmental phenols” because the laboratory measures them with other environmental phenols.

⁶ Includes *n*-butylparaben and isobutylparaben.

⁷ Fungicides, herbicides, and insecticides are grouped under the general heading of “Pesticides.”

⁸ Includes di-*n*-butyl phthalate and di-isobutyl phthalate.

⁹ 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.