

**Biomonitoring California
Priority Chemicals
June 2014**

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. The Program determines the chemicals that are actually biomonitored and the appropriate targets for measurement. To jump to each footnote referenced in the list below, click on the relevant number.

Brominated and Chlorinated Organic Compounds used as Flame Retardants ¹

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)

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

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)

Hydroxy-PBDEs (Metabolites of PBDEs)

4'-Hydroxy-BDE 17
4-Hydroxy-BDE 42
3-Hydroxy-BDE 47
5-Hydroxy-BDE 47
6-Hydroxy-BDE 47
4'-Hydroxy-BDE 49
2'-Hydroxy-BDE 68
4-Hydroxy-BDE 90
5'-Hydroxy-BDE 99
6'-Hydroxy-BDE 99
3-Hydroxy-BDE 100
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

***p,p'*-Bisphenols**¹

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

Pentachlorophenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Triclosan

Parabens³

Butylparaben⁶
Ethylparaben
Methylparaben
n-Propylparaben

Metals³

Antimony⁷
Arsenic
 Arsenic (V) acid
 Arsenobetaine
 Arsenocholine
 Arsenous (III) acid
 Dimethylarsinic acid
 Monomethylarsonic acid
 Trimethylarsine oxide
Beryllium⁷
Cadmium
Cobalt
Lead
Manganese
Mercury
Molybdenum
Thallium
Tungsten
Uranium

Non-Halogenated Aromatic Phosphates¹

Bisphenol A bis(diphenyl phosphate)
Butylated triphenyl phosphate
t-Butylphenyl diphenyl phosphate
2-Ethylhexyl diphenyl phosphate
Isodecyl diphenyl phosphate
Isopropyl phenyl 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 ^{3,8}

Herbicides ³

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

Organochlorine Pesticides ³

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

Organophosphate Insecticides ³

Acephate
Azinphos methyl
Dimethyldithiophosphate
Dimethylphosphate
Dimethylthiophosphate
Chlorethoxyphos
Diethylphosphate
Diethylthiophosphate
Chlorpyrifos
Diethylphosphate
Diethylthiophosphate
3,5,6-Trichloro-2-pyridinol (TCPy)
Chlorpyrifos methyl
Dimethylphosphate
Dimethylthiophosphate
3,5,6-Trichloro-2-pyridinol (TCPy)
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
Diethylphosphate
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 ³

Allethrin
cis/trans-Dimethylvinylcyclopropane carboxylic diacid
Cyfluthrin
cis-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*cis*-DCCA)
trans-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*trans*-DCCA)
4-Fluoro-3-phenoxybenzoic acid
Cyhalothrin (including *lambda*- and *gamma*-)
3-Phenoxybenzoic acid (3-PBA)
Cypermethrin (including *cis*- and *trans*-)
cis-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*cis*-DCCA)
trans-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*trans*-DCCA)
3-Phenoxybenzoic acid (3-PBA)
Deltamethrin
cis-3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid
3-Phenoxybenzoic acid (3-PBA)
Fenpropathrin
3-Phenoxybenzoic acid (3-PBA)
Permethrin (including *cis*- and *trans*-)
cis-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*cis*-DCCA)
trans-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*trans*-DCCA)
3-Phenoxybenzoic acid (3-PBA)
Pyrethrin 1
cis/trans-Dimethylvinylcyclopropane carboxylic diacid

Resmethrin
cis/trans-Dimethylvinylcyclopropane carboxylic diacid
Tralomethrin
3-Phenoxybenzoic acid (3-PBA)

Other Pesticides

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

Phthalates ³

Benzylbutyl phthalate (BzBP)
Mono-benzyl phthalate (MBzP)
Mono-*n*-butyl phthalate (MnBP)
Dibutyl phthalate (DBP) ⁹
Mono-*n*-butyl phthalate (MnBP)
Mono-isobutyl phthalate (MIBP)
Dicyclohexyl phthalate (DCHP)
Mono-cyclohexyl phthalate (MCHP)
Diethyl phthalate (DEP)
Mono-ethyl phthalate (MEP)
Di-2-ethylhexyl phthalate (DEHP)
Mono-(2-ethyl-5-carboxypentyl) phthalate (MECPP)
Mono-2-ethylhexyl phthalate (MEHP)
Mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP)
Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)
Di-isodecyl phthalate (DIDP)
Mono-(carboxynonyl) phthalate (MCNP)
Di-isononyl phthalate (DINP)
Mono-(carboxyoctyl) phthalate (MCOP)
Mono-(hydroxyisononyl) phthalate
Mono-isononyl phthalate (MINP)
Mono-(oxoisononyl) phthalate
Dimethyl phthalate (DMP)
Mono-methyl phthalate (MMP)
Di-*n*-octyl phthalate (DnOP)
Mono-(3-carboxypropyl) phthalate (MCP)
Mono-*n*-octyl phthalate (MnOP)

Polychlorinated Biphenyls (PCBs), Dioxin-Like ³

Coplanar PCBs ³

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 ³

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',3,3,4,4',5'-Hexachlorobiphenyl (PCB 138)
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)
2,3,3',4,4',6-Hexachlorobiphenyl (PCB 158)
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',3,3',4,5,5',6-Octachlorobiphenyl (PCB 199)
2,2',3,4,4',5,5',6-Octachlorobiphenyl (PCB 203)
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) ^{3,10}**

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

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 193

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 These chlorinated phenols, with the exception of triclosan, are metabolites of certain pesticides that 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 The SGP recommended that the Program develop methods for antimony and beryllium that meet the Program's quality assurance/quality control (QA/QC) standards.

⁸ Fungicides, herbicides, and insecticides are grouped under the general heading of “Pesticides.”

⁹ Includes di-*n*-butyl phthalate and di-isobutyl phthalate.

¹⁰ 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.