

## Biomonitoring California Designated Chemicals June 2021

The following is a list of designated chemicals for Biomonitoring California.<sup>a</sup> Designated chemicals consist of those substances that are included in the Centers for Disease Control and Prevention's (CDC's) biomonitoring studies<sup>b</sup> and additional chemicals that are recommended by the Scientific Guidance Panel (SGP) for Biomonitoring California. Designated chemicals are the pool of chemicals from which the SGP can recommend priority chemicals for biomonitoring.

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.

### Acrylamide

Acrylamide hemoglobin adducts  
Glycidamide hemoglobin adducts  
*N*-Acetyl-*S*-(2-carbamoyl-2-hydroxyethyl)-*L*-cysteine  
*N*-Acetyl-*S*-(2-carbamoylethyl)-*L*-cysteine

### Antimicrobials used in Food Production <sup>1</sup>

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

Allyl 2,4,6-tribromophenyl ether (ATE)  
2,2-Bis(bromomethyl)-1,3-propanediol  
Bis(2-chloroethyl) (2-chloroethyl)phosphonate  
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  
Chlorinated paraffins  
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)  
2,3,4,5-Tetrabromobenzoic acid (TBBA)  
*N,N'*-Ethylenebis(tetrabromophthalimide)  
Hexabromobenzene (HBB)  
2,2',4,4',5,5'-Hexabromobiphenyl (BB 153)  
Hexabromocyclododecane (HBCD)  
Hexachlorocyclopentadienyl-dibromocyclooctane  
2-Hydroxypropyl 2-(2-hydroxyethyl)ethyl tetrabromophthalate  
Isobutoxypentabromocyclododecanes (iBPBCDs)  
Octabromotrimethylphenylindane (OBIND)  
Pentabromoethylbenzene (PBEB)  
Pentabromophenol (PBP)  
Pentabromotoluene (PBT)  
1,1'-Sulfonylbis[3,5-dibromo-4-(2,3-dibromopropoxy) benzene  
Tetrabromobisphenol A (TBBPA)  
Tetrabromobisphenol A bis(2,3-dibromopropyl) ether (TBBPA-DBPE)  
Tetrabromobisphenol A bis(2-hydroxyethyl) ether  
Tetrabromobisphenol A diallyl ether  
Tetrabromophthalic acid, mixed esters  
Tetrabromophthalic anhydride  
2,3,5,6-Tetrabromo-*p*-xylene  
Tetrachlorophthalic anhydride  
2,4,6-Tribromophenol  
Tribromoneopentylalcohol  
Tris(2-chloroethyl)phosphate (TCEP)  
Bis(2-chloroethyl)phosphate (BCEP)  
Tris(1-chloro-2-propyl)phosphate (TCPP)  
Bis(1-chloro-2-propyl)phosphate (BCPP)

- a. California Environmental Contaminant Biomonitoring Program, codified at Health and Safety Code section 105440 et seq.
- b. Known collectively as the National Reports on Human Exposure to Environmental Chemicals program.

Tris(2,3-dibromopropyl) isocyanurate  
Tris(2,3-dibromopropyl)phosphate (TDBPP)  
Tris(1,3-dichloro-2-propyl)phosphate (TDCPP)  
Bis(1,3-dichloro-2-propyl)phosphate (BDCPP)  
Tris(2,3-dichloro-1-propyl)phosphate  
Tris(tribromoneopentyl)phosphate  
2,4,6-Tris(2,4,6-tribromophenoxy)-1,3,5-triazine

**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)

**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

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

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

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

1-Nitropyrene  
6-Hydroxy-1-nitropyrene  
8-Hydroxy-1-nitropyrene

**Diglycidyl Ethers of *p,p'*-Bisphenols** <sup>1</sup>

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

**Disinfection By-Products  
(Trihalomethanes)** <sup>3</sup>

Bromodichloromethane  
Dibromochloromethane  
Tribromomethane (Bromoform)  
Trichloromethane (Chloroform)

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

Benzophenone-3  
4-*t*-Octylphenol  
*o*-Phenylphenol

***p,p'*-Bisphenols** <sup>1</sup>

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

**Brominated phenols** <sup>3, 4</sup>

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

**Chlorinated phenols** <sup>3, 5</sup>

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

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

Butylparaben <sup>6</sup>  
Ethylparaben  
Methylparaben  
*n*-Propylparaben

**Related chemicals**

Triclocarban <sup>7</sup>

**Heterocyclic Amines** <sup>3</sup>

3-Amino-1,4-dimethyl-5*H*-pyrido[4,3-*b*]indole  
(Trp-P-1)  
2-Aminodipyrido[1,2-*a*:3',2'-*d*]imidazole (Glu-P-2)

2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole (Glu-P-1)  
2-Amino-3-methylimidazo[4,5-f]quinoline (IQ)  
2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (PhIP)  
2-Amino-3-methyl-9H-pyrido[2,3-b]indole (MeA- $\alpha$ -C)  
2-Amino-9H-pyrido[2,3-b]indole (A- $\alpha$ -C)  
1-Methyl-3-amino-5H-pyrido[4,3-b]indole (Trp-P-2)  
1-Methyl-9H-pyrido[3,4-b]indole (Harman)  
9H-Pyrido[3,4-b]indole (Norharman)

### Metals <sup>3</sup>

Antimony  
Arsenic  
    Arsenic (V) acid  
    Arsenobetaine  
    Arsenocholine  
    Arsenous (III) acid  
    Dimethylarsinic acid  
    Monomethylarsonic acid  
    Trimethylarsine oxide  
Barium  
Beryllium  
Cadmium  
Cesium  
Chromium  
Cobalt  
Copper  
Lead  
Manganese  
Mercury  
    Ethyl mercury  
    Methyl mercury  
Molybdenum  
Platinum  
Selenium  
Strontium  
Thallium  
Tin  
Tungsten  
Uranium  
Zinc

### Non-Halogenated Aromatic Phosphates <sup>1</sup>

Bisphenol A bis(diphenyl phosphate)  
Butylated triphenyl phosphate  
Butyldiphenyl phosphate  
*t*-Butylphenyl diphenyl phosphate  
Dibutylphenyl phosphate  
2-Ethylhexyl diphenyl phosphate  
Isodecyl diphenyl phosphate  
Isopropyl phenyl diphenyl phosphate  
Isopropylated triphenyl phosphate  
Resorcinol bis(diphenyl phosphate)  
Tribenzyl phosphate (TBzP)  
    Dibenzyl phosphate (DBzP)

Tricresyl phosphate (TCP)  
Tri-*o*-cresylphosphate (ToCP)  
    Di-*o*-cresylphosphate (DoCP)  
Tri-*p*-cresylphosphate (TpCP)  
    Di-*p*-cresylphosphate (DpCP)  
Triphenyl phosphate (TPP)  
Diphenyl phosphate (DPhP)

### Organophosphate Flame Retardants (OPFRs) <sup>3</sup>

Tri-*n*-butyl phosphate (TBuP)  
Dibutyl phosphate (DBuP)

*Additional OPFRs are listed under the categories "Brominated and Chlorinated Organic Compounds used as Flame Retardants" and "Non-Halogenated Aromatic Phosphates."*

### Perchlorate and Other Anions <sup>8</sup>

Perchlorate  
**Other Anions**  
Nitrate  
Thiocyanate

### Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs) <sup>1, 9</sup>

Ammonium 4,8-dioxa-3H-perfluorononanoate (ADONA)  
Bis(perfluorohexyl)phosphinic acid (6:6 PFPiA)  
Bis(perfluorooctyl)phosphinic acid (8:8 PFPiA)  
6:2 Chlorinated polyfluorinated ether sulfonic acid (F-53B major)  
8:2 Chlorinated polyfluorinated ether sulfonic acid (F-53B minor)  
*N*-Ethyl-*N*-(2-hydroxyethyl)perfluoro-octanesulfonamide phosphate diester  
*N*-Ethyl-*N*-(2-hydroxyethyl)perfluoro-octanesulfonamide phosphate monoester  
*N*-Ethyl-perfluorooctane sulfonamido acetic acid (Et-PFOSA-AcOH)  
6:2 Fluorotelomer acetate  
8:2 Fluorotelomer acetate  
10:2 Fluorotelomer acetate  
6:2 Fluorotelomer acrylate  
8:2 Fluorotelomer acrylate  
10:2 Fluorotelomer acrylate  
5:3 Fluorotelomer carboxylic acid (5:3 FTCA)  
6:2 Fluorotelomer carboxylic acid (6:2 FTCA)  
7:3 Fluorotelomer carboxylic acid (7:3 FTCA)  
8:2 Fluorotelomer carboxylic acid (8:2 FTCA)  
10:2 Fluorotelomer carboxylic acid (10:2 FTCA)  
6:2 Fluorotelomer phosphate diester (6:2 diPAP)  
8:2 Fluorotelomer phosphate diester (8:2 diPAP)  
6:2 Fluorotelomer phosphate monoester (6:2 PAP)  
8:2 Fluorotelomer phosphate monoester (8:2 PAP)

4:2 Fluorotelomer sulfonic acid (4:2 FTS)  
6:2 Fluorotelomer sulfonic acid (6:2 FTS)  
8:2 Fluorotelomer sulfonic acid (8:2 FTS)  
6:2 Fluorotelomer unsaturated carboxylic acid (6:2 FTUCA)  
8:2 Fluorotelomer unsaturated carboxylic acid (8:2 FTUCA)  
10:2 Fluorotelomer unsaturated carboxylic acid (10:2 FTUCA)  
N-Methyl-perfluorooctane sulfonamido acetic acid (Me-PFOSA-AcOH)  
Perfluorobutane sulfonic acid (PFBS)  
Perfluorobutanoic acid (PFBA)  
Perfluorodecane sulfonic acid (PFDS)  
Perfluorodecanoic acid (PFDeA)  
Perfluorodecylphosphonic acid  
Perfluoro-3,6-dioxaheptanoic acid  
Perfluoro-3,6-dioxa-4-methyl-7-octene sulfonic acid  
Perfluorododecanoic acid (PFDoA)  
Perfluoro(2-ethoxyethane) sulfonic acid  
Perfluoroethylcyclohexane sulfonic acid  
Perfluoroheptane sulfonic acid (PFHpS)  
Perfluoroheptanoic acid (PFHpA)  
Perfluorohexadecanoic acid  
Perfluorohexane sulfonic acid (PFHxS)  
Perfluorohexanoic acid (PFHxA)  
Perfluorohexylperfluorooctylphosphinic acid (6:8 PFPiA)  
Perfluorohexylphosphonic acid (PFHxPA)  
Perfluoro-4-methoxybutanoic acid  
Perfluoro-3-methoxypropanoic acid  
Perfluoro-2-methyl-3-oxahexanoic acid (GenX)  
Perfluorononane sulfonic acid (PFNS)  
Perfluorononanoic acid (PFNA)  
Perfluorooctadecanoic acid  
Perfluorooctane sulfonamide (PFOSA)  
Perfluorooctane sulfonic acid (PFOS), including linear and branched isomers  
Perfluorooctanoic acid (PFOA), including linear and branched isomers  
Perfluorooctylphosphonic acid (PFOPA)  
Perfluoropentane sulfonic acid (PFPeS)  
Perfluoropentanoic acid (PFPeA)  
Perfluorotetradecanoic acid (PFTeDA)  
Perfluorotridecanoic acid  
Perfluoroundecanoic acid (PFUA)

**Pesticides [3](#), [10](#)**

**Carbamate Insecticides [3](#)**

Benfuracarb  
Carbofuranphenol  
Carbaryl  
    1-Hydroxynaphthalene [11](#)  
    2-Hydroxynaphthalene [11](#)  
Carbofuran  
    Carbofuranphenol  
Carbosulfan  
    Carbofuranphenol

Furathiocarb  
Carbofuranphenol  
Propoxur  
    2-Isopropoxyphenol

**Fungicides [3](#)**

Captafol  
    Tetrahydrophthalimide  
Captan  
    Phthalimide  
    Tetrahydrophthalimide  
Chlorothalonil  
Dichloran  
Folpet  
    Phthalimide  
Iprodione  
Mancozeb  
    Ethylene thiourea  
Maneb  
    Ethylene thiourea  
Metalaxyl  
Metiram  
    Ethylene thiourea  
Nabam  
    Ethylene thiourea  
Pentachlorophenol  
o-Phenylphenol  
Propineb  
    Propylene thiourea  
Thiram  
    Ethylene thiourea  
Ziram  
    Ethylene thiourea

**Herbicides - Substituted Ureas [3](#)**

Bensulfuron-methyl  
Chlorimuron-ethyl  
Chlorsulfuron  
Diuron  
Ethametsulfuron-methyl  
Foramsulfuron  
Halosulfuron  
Iodosulfuron  
Linuron  
Mesosulfuron-methyl  
Metsulfuron-methyl  
Nicosulfuron  
Oxasulfuron  
Primisulfuron-methyl  
Prosulfuron  
Rimsulfuron  
Sulfometuron-methyl  
Sulfosulfuron  
Thifensulfuron-methyl  
Triasulfuron  
Triflurosulfuron-methyl  
Non-specific metabolites  
    Dimethoxy pyrimidine  
    Dimethyl pyrimidine  
    Methyl methoxytriazine

**Neonicotinoid Insecticides** <sup>3</sup>

Acetamiprid  
N-Desmethyl-acetamiprid  
Clothianidin  
Imidacloprid  
5-Hydroxy-imidacloprid  
Thiacloprid

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

Aldrin  
Dieldrin  
Chlordane  
*trans*-Nonachlor  
Oxychlordane  
Dichlorodiphenyltrichloroethane (DDT) (including *p,p'*-DDT and *o,p'*-DDT)  
*p,p'*-Dichlorodipenyldichloroethene (*p,p'*-DDE)  
Dieldrin  
Endosulfan  
Endosulfan-ether  
Endosulfan-lactone  
Endosulfan-sulfate  
Endrin  
Heptachlor  
Heptachlor epoxide  
Hexachlorobenzene  
Pentachlorophenol  
2,4,5-Trichlorophenol  
2,4,6-Trichlorophenol  
Hexachlorocyclohexanes (HCH) (including *beta*-HCH and *gamma*-HCH [lindane])  
Pentachlorophenol  
2,4,5-Trichlorophenol  
2,4,6-Trichlorophenol  
Methoxychlor  
Dihydroxy methoxychlor  
Monohydroxy methoxychlor  
Mirex  
2,4,5-Trichlorophenol  
2,4,6-Trichlorophenol

**Organophosphorus Pesticides** <sup>1</sup>

Acephate  
Azinphos methyl  
Dimethyldithiophosphate  
Dimethylphosphate  
Dimethylthiophosphate  
Bensulide  
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 (IMPY)  
Dichlorvos (DDVP)  
Dimethylphosphate  
Dicrotophos  
Dimethylphosphate  
Dimethoate  
Dimethyldithiophosphate  
Dimethylphosphate  
Dimethylthiophosphate  
Omethoate  
Disulfoton  
Diethyldithiophosphate  
Diethylphosphate  
Diethylthiophosphate  
Ethion  
Diethyldithiophosphate  
Diethylphosphate  
Diethylthiophosphate  
Ethoprop  
Fenitrothion  
Dimethylphosphate  
Dimethylthiophosphate  
Fenthion  
Dimethylphosphate  
Dimethylthiophosphate  
Glufosinate-ammonium  
3-Methylphosphinicopropionic acid (3-MPPA)  
Glyphosate  
Aminomethylphosphonic acid (AMPA)  
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  
 Sulfotep  
 Diethylphosphate  
 Diethylthiophosphate  
 Temephos  
 Dimethylphosphate  
 Dimethylthiophosphate  
 Terbufos  
 Diethyldithiophosphate  
 Diethylphosphate  
 Diethylthiophosphate  
 Tetrachlorvinphos  
 Dimethylphosphate  
 Tribufos

**Quaternary Ammonium Herbicides and Pesticides** <sup>1</sup>

*Refer to the category Quaternary Ammonium Compounds (QACs) for the QA herbicides and other members of this class, some of which are registered as pesticides for antimicrobial applications.*

**Pyrethroid Pesticides** <sup>1</sup>

Allethrin  
*cis/trans*-Dimethylvinylcyclopropane carboxylic diacid  
 Bifenthrin  
 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)  
 Cyphenothrin  
 Deltamethrin  
*cis*-3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid  
 3-Phenoxybenzoic acid (3-PBA)  
 Esbiothrin  
 Esfenvalerate  
 Etofenprox  
 Fenpropathrin  
 3-Phenoxybenzoic acid (3-PBA)  
 Fenvalerate  
 Imiprothrin  
 Metofluthrin  
 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)  
 Phenothrin (Sumithrin)  
 Prallethrin  
 Pyrethrin 1  
*cis/trans*-Dimethylvinylcyclopropane carboxylic diacid  
 Resmethrin  
*cis/trans*-Dimethylvinylcyclopropane carboxylic diacid  
 Tetramethrin  
 Tralomethrin  
 3-Phenoxybenzoic acid (3-PBA)

**Other Herbicides**

Acetochlor  
 Acetochlor mercapturate  
 Alachlor  
 Alachlor mercapturate  
 Atrazine  
 Atrazine mercapturate  
 Diaminochlorotriazine  
 Desethylatrazine  
 Desisopropylatrazine  
 Hydroxyatrazine  
 Dacthal  
 2,4-Dichlorophenoxyacetic acid (2,4-D), salts and esters  
 2,4-Dichlorophenoxyacetic acid  
 2,4-Dichlorophenol  
 Metolachlor  
 Metolachlor mercapturate  
 Pendimethalin  
 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T), salts and esters  
 2,4,5-Trichlorophenoxyacetic acid  
 Trifluralin

**Other Pesticides**

1,4-Dichlorobenzene (*p*-Dichlorobenzene)  
2,5-Dichlorophenol  
*N,N*-Diethyl-3-methylbenzamide (DEET)  
3-Diethylcarbamoyl benzoic acid (DCBA)  
*N,N*-Diethyl-3-(hydroxymethyl) benzamide (DHMB)  
Fipronil  
Octhilinone

Cyclohexane-1,2-dicarboxylic acid-mono (hydroxy-isononyl ester) (MHNCH)  
Di-2-ethylhexyl terephthalate (DEHTP)  
Mono-2-ethyl-5-carboxypentyl terephthalate (MECPTP)  
Mono-2-ethyl-5-hydroxyhexyl terephthalate (MEHHTP)

**ortho-Phthalates <sup>1</sup>**

Benzylbutyl phthalate (BzBP)  
Mono-benzyl phthalate (MBzP)  
Mono-*n*-butyl phthalate (MnBP)  
Diallyl phthalate  
Di-*n*-butyl phthalate (DnBP)  
Mono-*n*-butyl phthalate (MnBP)  
Mono-3-hydroxybutyl phthalate (MHBP)  
Di-isobutyl phthalate (DIBP)  
Mono-isobutyl phthalate (MIBP)  
Mono-2-methyl-2-hydroxypropyl phthalate  
Dicyclohexyl phthalate (DCHP)  
Mono-cyclohexyl phthalate (MCHP)  
Diethyl phthalate (DEP)  
Mono-ethyl phthalate (MEP)  
Di-2-ethylhexyl phthalate (DEHP)  
Mono-(2-carboxymethylhexyl) phthalate  
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-*n*-hexyl phthalate  
Di-isodecyl phthalate (DIDP)  
Mono-(carboxynonyl) phthalate (MCNP)  
Di-isoheptyl phthalate  
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 (MCPP)  
Mono-*n*-octyl phthalate (MnOP)  
Di-*n*-pentyl phthalate  
Di-2-propylheptyl phthalate  
Diundecyl phthalate  
Di-isodecyl phthalate  
Di-isotridecyl phthalate

**Phytoestrogens <sup>3</sup>**

Daidzein  
O-Desmethylangolensin  
Equol  
Enterodiol  
Enterolactone  
Genistein

**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 114)  
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)  
2',3,4,4',5-Pentachlorobiphenyl (PCB 123)  
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'-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)

**Phthalate Alternatives <sup>3</sup>**

1,2-Cyclohexane dicarboxylic acid, diisononyl ester (DINCH)  
Cyclohexane-1,2-dicarboxylic acid mono carboxyisooctyl ester (MCOCH)

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)

### Polychlorinated Biphenyls (PCBs)

#### Hydroxy-PCBs (Metabolites of PCBs) <sup>12</sup>

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

### Polychlorinated Dibenzo-*p*-dioxins <sup>3</sup>

1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin  
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin  
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin  
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin  
1,2,3,4,6,7,8,9-Octachlorodibenzo-*p*-dioxin  
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin  
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD)

### Polychlorinated Dibenzofurans <sup>3</sup>

1,2,3,4,6,7,8-Heptachlorodibenzofuran  
1,2,3,4,7,8,9-Heptachlorodibenzofuran  
1,2,3,4,7,8-Hexachlorodibenzofuran  
1,2,3,6,7,8-Hexachlorodibenzofuran  
1,2,3,7,8,9-Hexachlorodibenzofuran  
2,3,4,6,7,8-Hexachlorodibenzofuran  
1,2,3,4,6,7,8,9-Octachlorodibenzofuran  
1,2,3,7,8-Pentachlorodibenzofuran  
2,3,4,7,8-Pentachlorodibenzofuran  
2,3,7,8-Tetrachlorodibenzofuran

### Polycyclic Aromatic Hydrocarbons (PAHs) <sup>3</sup>

Benz[*a*]anthracene  
1-Hydroxybenz[*a*]anthracene  
3-Hydroxybenz[*a*]anthracene  
9-Hydroxybenz[*a*]anthracene  
Benzo[*a*]pyrene  
3-Hydroxybenzo[*a*]pyrene  
Benzo[*c*]phenanthrene  
1-Hydroxybenzo[*c*]phenanthrene  
2-Hydroxybenzo[*c*]phenanthrene

3-Hydroxybenzo[*c*]phenanthrene  
Chrysene  
1-Hydroxychrysene  
2-Hydroxychrysene  
3-Hydroxychrysene  
4-Hydroxychrysene  
6-Hydroxychrysene  
Fluoranthene  
3-Hydroxyfluoranthene  
Fluorene  
2-Hydroxyfluorene  
3-Hydroxyfluorene  
9-Hydroxyfluorene  
Naphthalene  
1-Hydroxynaphthalene  
2-Hydroxynaphthalene  
Phenanthrene  
1-Hydroxyphenanthrene  
2-Hydroxyphenanthrene  
3-Hydroxyphenanthrene  
4-Hydroxyphenanthrene  
9-Hydroxyphenanthrene  
Pyrene  
1-Hydroxypyrene

### Quaternary Ammonium Compounds (QACs) <sup>1</sup>

#### Alkyltrimethyl ammonium compounds (ATMACs) <sup>1</sup>

C20-22-Alkyltrimethyl ammonium chlorides  
Behentrimonium chloride  
Cetrimonium bromide  
Cetrimonium chloride

#### Benzylalkyldimethyl ammonium compounds (BACs) <sup>1</sup>

Alkyl(60%C14, 30%C16, 5%C18, 5%C12)  
dimethylbenzyl ammonium chloride  
C12-14-Alkyl(ethylbenzyl)dimethyl ammonium  
chlorides  
Benzalkonium chloride <sup>13</sup>  
Benzyl-C12-18-alkyldimethyl ammonium chlorides  
Cetalkonium chloride

#### Dialkyldimethyl ammonium compounds (DADMACs) <sup>1</sup>

Di-C14-18-alkyldimethyl ammonium chlorides  
Didecyldimethyl ammonium carbonate  
Didecyldimethyl ammonium chloride  
Dioctyldimethyl ammonium chloride  
Quaternium 18  
Quaternium 24  
Quaternium 34

#### Esterquats <sup>1</sup>

Esterquat 1

#### Polyquaternium compounds (Polyquats) <sup>1</sup>

Polyquaternium 42



**QA Herbicides** <sup>1</sup>

Diquat dibromide  
Paraquat dichloride

**Other QACs** <sup>1</sup>

Benzethonium chloride  
Cetylpyridinium chloride  
(Oxydi-2,1-ethanediyl)bis(coco alkyl)dimethyl  
ammonium dichlorides  
Quaternium 15

**Synthetic Hormones used in Food  
Production** <sup>1</sup>

Melengestrol acetate  
Trenbolone acetate  
Zeranol

**Synthetic Polycyclic Musks** <sup>1</sup>

4-Acetyl-1,1-dimethyl-6-tert-butylindan (ADBI)  
6-Acetyl-1,1,2,3,3,5-hexamethylindane (AHMI)  
7-Acetyl-1,1,3,4,4,6-hexamethyl-  
tetrahydronaphthalene (AHTN)  
5-Acetyl-1,1,2,6-tetramethyl-3-isopropylindan  
(ATII)  
Acetylethyltetramethyltetralin (AETT)  
6,7-Dihydro-1,1,2,3,3-pentamethyl-4[5H]indanone  
(DPMI)  
1,3,4,6,7,8-Hexahydro-4,6,6,7,8-hexamethyl-  
cyclopenta[g]-2-benzopyran (HHCB)

**Tetramethyl  
Acetyloctahydronaphthalenes** <sup>1</sup>

1-(1,2,3,4,6,7,8,8a-Octahydro-2,3,8,8-tetramethyl-  
2-naphthalenyl)ethanone (alpha isomer)  
1-(1,2,3,4,5,6,7,8-Octahydro-2,3,8,8-tetramethyl-  
2-naphthalenyl)ethanone (beta isomer; OTNE)  
1-(1,2,3,5,6,7,8,8a-Octahydro-2,3,8,8-tetramethyl-  
2-naphthalenyl)ethanone (gamma isomer)  
1-(1,2,3,4,5,6,7,8-Octahydro-2,3,5,5-tetramethyl-  
2-naphthalenyl)ethanone

**Tobacco Smoke**

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

**Volatile Organic Compounds** <sup>3</sup>

Acrolein  
N-Acetyl-S-(2-carboxyethyl)-L-cysteine  
N-Acetyl-S-(3-hydroxypropyl)-L-cysteine

Acrylonitrile  
N-Acetyl-S-(2-cyanoethyl)-L-cysteine  
N-Acetyl-S-(2-hydroxyethyl)-L-cysteine  
Benzene  
N-Acetyl-S-(phenyl)-L-cysteine  
*t,t*-Muconic acid  
Benzonitrile  
1-Bromopropane  
N-Acetyl-S-(*n*-propyl)-L-cysteine  
1,3-Butadiene  
N-Acetyl-S-(3,4-dihydroxybutyl)-L-cysteine  
N-Acetyl-S-(2-hydroxy-3-butenyl)-L-cysteine  
N-Acetyl-S-(4-hydroxy-2-butenyl)-L-cysteine  
N-Acetyl-S-(1-hydroxymethyl-2-propenyl)-L-  
cysteine  
Carbon disulfide  
2-Thioxothiazolidine-4-carboxylic acid  
Carbon tetrachloride  
Chlorobenzene  
Chloroethane  
Crotonaldehyde  
N-Acetyl-S-(3-hydroxypropyl-1-methyl)-L-  
cysteine  
Cyanide  
2-Aminothiazoline-4-carboxylic acid  
Cyclohexane  
Dibromomethane  
1,2-Dibromo-3-chloropropane (DBCP)  
1,2-Dibromoethane  
1,2-Dichlorobenzene (*o*-Dichlorobenzene)  
1,3-Dichlorobenzene (*m*-Dichlorobenzene)  
1,4-Dichlorobenzene (*p*-Dichlorobenzene)  
1,1-Dichloroethane  
1,2-Dichloroethane  
1,1-Dichloroethene  
*cis*-1,2-Dichloroethene  
*trans*-1,2-Dichloroethene  
Dichloromethane (Methylene chloride)  
1,2-Dichloropropane  
Diethylether  
*N,N*-Dimethylformamide  
N-Acetyl-S-(*N*-methylcarbamoyl)-L-cysteine  
2,5-Dimethylfuran  
Ethyl acetate  
Ethylbenzene  
Phenylglyoxylic acid  
Ethylene oxide  
N-Acetyl-S-(2-hydroxyethyl)-L-cysteine  
Furan  
Hexachloroethane  
Heptane  
Isobutyronitrile  
Isopropylbenzene (Cumene)  
Methyl-*t*-butyl ether (MTBE)  
Methylcyclopentane  
Nitrobenzene  
Nitromethane  
Octane

Propylene oxide  
  *N*-Acetyl-*S*-(2-hydroxypropyl)-*L*-cysteine  
Styrene  
  *N*-Acetyl-*S*-(1-phenyl-2-hydroxyethyl)-*L*-  
  cysteine  
  *N*-Acetyl-*S*-(2-phenyl-2-hydroxyethyl)-*L*-  
  cysteine  
Mandelic acid  
Phenylglyoxylic acid  
1,1,1,2-Tetrachloroethane  
1,1,2,2-Tetrachloroethane  
Tetrachloroethene (Perchloroethylene)  
  *N*-Acetyl-*S*-(trichlorovinyl)-*L*-cysteine  
Tetrahydrofuran  
1,1,1-Trichloroethane  
1,1,2-Trichloroethane  
Trichloroethene (Trichloroethylene)  
  *N*-Acetyl-*S*-(1,2-dichlorovinyl)-*L*-cysteine  
  *N*-Acetyl-*S*-(2,2-dichlorovinyl)-*L*-cysteine  
1,2,3-Trichloropropane  
 $\alpha,\alpha,\alpha$ -Trifluorotoluene  
Toluene  
  *N*-Acetyl-*S*-(benzyl)-*L*-cysteine  
Vinyl bromide  
Vinyl chloride  
  *N*-Acetyl-*S*-(2-hydroxyethyl)-*L*-cysteine  
*m*-Xylene  
  *N*-Acetyl-*S*-(dimethylphenyl)-*L*-cysteine  
  3-Methylhippuric acid  
*o*-Xylene  
  *N*-Acetyl-*S*-(dimethylphenyl)-*L*-cysteine  
  2-Methylhippuric acid  
*p*-Xylene  
  *N*-Acetyl-*S*-(dimethylphenyl)-*L*-cysteine  
  4-Methylhippuric acid

**Notes**

- <sup>1</sup> All members of the chemical group are designated chemicals, including, but not limited to, the chemicals shown.
- <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 group are not designated chemicals; only the specific chemicals listed are designated chemicals.
- <sup>4</sup> These brominated phenols are part of the chemical group “brominated and chlorinated organic chemicals used as flame retardants”, which are listed as designated chemicals. The brominated phenols are also included in the category “environmental phenols” because the laboratory measures them with other environmental phenols.
- <sup>5</sup> These chlorinated phenols, with the exception of triclosan, are metabolites of certain pesticides that are listed as designated chemicals. These chlorinated phenols are also included in the category “environmental phenols” because the laboratory measures them with other environmental phenols.
- <sup>6</sup> Includes *n*-butylparaben and isobutylparaben.
- <sup>7</sup> Triclocarban is not a phenol but can be analytically measured with environmental phenols. When it is released into the environment, it is commonly found in the same environmental media as triclosan.
- <sup>8</sup> CDC measures nitrate and thiocyanate along with perchlorate, because all three anions can affect iodine uptake by the thyroid.
- <sup>9</sup> PFASs are fluorinated aliphatic substances that contain the moiety  $C_nF_{2n+1}$ . In a perfluoroalkyl substance, all carbon atoms, except for carbon atoms associated with functional groups (such as an aldehyde group), are fully fluorinated. In a polyfluoroalkyl substance, at least one (but not all) of the carbon atoms is fully fluorinated. For complete technical details on the definition of PFASs, see Buck et al. (2011), *Integr Environ Assess Manag* 7(4):513–541 (link to free article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3214619/>).
- <sup>10</sup> Fungicides, herbicides, and insecticides are grouped under the general heading of “Pesticides.”
- <sup>11</sup> 1-Hydroxynaphthalene is the metabolite of both carbaryl and naphthalene. To determine the percent of 1-hydroxynaphthalene attributable to carbaryl alone, 2-hydroxynaphthalene (which is only a metabolite of naphthalene) must also be measured.
- <sup>12</sup> Hydroxy-PCBs are measured as biomarkers of exposure to the listed PCBs.
- <sup>13</sup> Benzalkonium chloride can also be referred to as alkyldimethylbenzyl ammonium chloride (ADBAC).