

## Biomonitoring California Designated Chemicals July 2010

The designated chemicals for Biomonitoring California<sup>a</sup> are provided in this list. Designated chemicals consist of those substances that are included in the Centers for Disease Control and Prevention'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. The parent chemical is provided in the list below, with other targets for biomonitoring shown indented underneath for some parent chemicals.

### Acrylamide

Acrylamide hemoglobin adducts  
Glycidamide hemoglobin adducts

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

### 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>

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

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

Bromodichloromethane  
Dibromochloromethane  
Tribromomethane (Bromoform)  
Trichloromethane (Chloroform)

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

Benzophenone-3  
Bisphenol A  
4-*tert*-Octylphenol  
Triclocarban<sup>4</sup>  
Triclosan

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

Butylparaben  
Ethylparaben  
Methylparaben  
Propylparaben

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

Antimony  
Arsenic  
    Arsenic (V) acid  
    Arsenobetaine  
    Arsenocholine  
    Arsenous (III) acid  
    Dimethylarsinic acid  
    Monomethylarsonic acid  
    Trimethylarsine oxide  
Barium  
Beryllium  
Cadmium  
Cesium  
Cobalt  
Lead  
Mercury  
Molybdenum  
Platinum  
Thallium  
Tungsten  
Uranium

**Perchlorate**

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

2-(N-Ethyl-perfluorooctane sulfonamide) acetic acid  
2-(N-Methyl-perfluorooctane sulfonamide) 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>**

**Carbamate Insecticides<sup>3</sup>**

Benfuracarb  
    Carbofuranphenol  
Carbaryl  
    1-Hydroxynaphthalene<sup>6</sup>  
    2-Hydroxynaphthalene<sup>6</sup>  
Carbofuran  
    Carbofuranphenol  
Carbosulfan  
    Carbofuranphenol  
Furathiocarb  
    Carbofuranphenol  
Propoxur  
    2-Isopropoxyphenol

**Fungicides<sup>3</sup>**

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**<sup>3</sup>

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

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

Aldrin  
    Dieldrin  
Chlordane  
    *trans*-Nonachlor  
    Oxychlordane  
Dichlorodiphenyltrichloroethane (DDT) (including  
    *p,p'*-DDT and *o,p'*-DDT)  
    *p,p'*-Dichlorodipenyldichloroethene (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

**Organophosphate 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	<i>trans</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
Dimethyldithiophosphate	4-Fluoro-3-phenoxybenzoic acid
Dimethylphosphate	Cyhalothrin (including <i>lambda</i> - and <i>gamma</i> -)
Dimethylthiophosphate	3-Phenoxybenzoic acid
Malathion dicarboxylic acid	Cypermethrin (including <i>cis</i> - and <i>trans</i> -)
Methamidophos	<i>cis</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
Methidathion	<i>trans</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
Dimethyldithiophosphate	3-Phenoxybenzoic acid
Dimethylphosphate	Cyphenothrin
Dimethylthiophosphate	Deltamethrin
Methyl parathion	<i>cis</i> -3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid
Dimethylphosphate	3-Phenoxybenzoic acid
Dimethylthiophosphate	Esbiothrin
<i>p</i> -Nitrophenol	Esfenvalerate
Naled	Etofenprox
Dimethylphosphate	Fenpropathrin
Oxydemeton-methyl	3-Phenoxybenzoic acid
Dimethylphosphate	Fenvalerate
Dimethylthiophosphate	Imiprothrin
Parathion (Ethyl parathion)	Metofluthrin
Diethylphosphate	Permethrin (including <i>cis</i> - and <i>trans</i> -)
Diethylthiophosphate	<i>cis</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
<i>p</i> -Nitrophenol	<i>trans</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
Phorate	3-Phenoxybenzoic acid
Diethyldithiophosphate	Phenothrin (sumithrin)
Diethylphosphate	Prallethrin
Diethylthiophosphate	Pyrethrin 1
Phosmet (Imidan)	<i>cis/trans</i> -Dimethylvinylcyclopropane carboxylic diacid
Dimethyldithiophosphate	Resmethrin
Dimethylphosphate	<i>cis/trans</i> -Dimethylvinylcyclopropane carboxylic diacid
Dimethylthiophosphate	Tetramethrin
Pirimiphos-methyl	Tralomethrin
2-(Diethylamino)-6-methylpyrimidin-4-ol/one	3-Phenoxybenzoic acid
Dimethylphosphate	
Dimethylthiophosphate	<b>Other Herbicides</b>
Sulfotepp	Acetochlor
Diethylphosphate	Acetochlor mercapturate
Diethylthiophosphate	Alachlor
Temephos	Alachlor mercapturate
Dimethylphosphate	Atrazine
Dimethylthiophosphate	Atrazine mercapturate
Terbufos	Diaminochlorotriazine
Diethyldithiophosphate	Desethylatrazine
Diethylphosphate	Desisopropylatrazine
Diethylthiophosphate	Hydroxyatrazine
Tetrachlorvinphos	Dacthal
Dimethylphosphate	
<b>Pyrethroid Pesticides</b> <sup>1</sup>	
Allethrin	
<i>cis/trans</i> -Dimethylvinylcyclopropane carboxylic diacid	
Bifenthrin	
Cyfluthrin	
<i>cis</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid	

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)

Fipronil

Octhilinone

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

Benzylbutyl phthalate (BzBP)

Mono-benzyl phthalate

Dibutyl phthalate (DBP)

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-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

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

Daidzein

O-Desmethylangolensin

Enterodiol

Enterolactone

Equol

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 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-Octachlorobiphenyl (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)

### 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

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

Melengestrol acetate  
Trenbolone acetate  
Zeranol

### Tobacco Smoke

Nicotine  
Cotinine

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

Benzene  
Carbon tetrachloride  
Chlorobenzene  
Dibromomethane  
1,2-Dibromo-3-chloropropane (DBCP)  
1,2-Dichlorobenzene (*o*-Dichlorobenzene)  
1,3-Dichlorobenzene (*m*-Dichlorobenzene)  
1,1-Dichloroethane  
1,2-Dichloroethane  
1,1-Dichloroethene  
*cis*-1,2-Dichloroethene  
*trans*-1,2-Dichloroethene  
Dichloromethane (Methylene chloride)  
1,2-Dichloropropane  
2,5-Dimethylfuran  
Ethylbenzene  
Hexachloroethane  
Methyl-*t*-butyl ether (MTBE)  
Nitrobenzene  
Styrene  
1,1,2,2-Tetrachloroethane  
Tetrachloroethylene (Perchloroethylene)  
1,1,1-Trichloroethane  
1,1,2-Trichloroethane  
Trichloroethylene  
Toluene  
*m*-Xylene  
*o*-Xylene  
*p*-Xylene

**Notes**

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<sup>1</sup> All members of the chemical class 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 class are not designated chemicals; only the specific chemicals listed are designated chemicals.

<sup>4</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>5</sup> Fungicides, herbicides, and insecticides are grouped under the general heading of "Pesticides."

<sup>6</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.