

# INITIAL RESULTS FROM BIOMONITORING CALIFORNIA COLLABORATIONS

Materials for Agenda Item on “Biomonitoring Findings”

Meeting of the Scientific Guidance Panel (SGP)

March 16, 2012

This is a progress report on the initial results of Biomonitoring California<sup>1</sup> collaborations, and is intended to serve as a starting point for public discussion of the Program’s next Data Summary Report,<sup>2</sup> which is projected to be issued in July 2012.

Every day people are exposed to thousands of chemicals in California’s environment as well as in common consumer products. Some of these chemicals have been associated with toxic effects, such as decreased fertility in women and impaired learning in children. Biomonitoring California is rapidly developing extensive analytical capabilities to measure low levels of chemicals in people. These analytical tools are starting to produce results for the public and policy-makers, and can help regulators evaluate which policies and public health efforts are most effective in reducing exposures to harmful chemicals. Biomonitoring results can inform California’s new Safer Consumer Products Program, which grew out of the Green Chemistry Initiative. Biomonitoring data can also help California researchers working to understand how chemical exposures can affect health.

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<sup>1</sup> California Environmental Contaminant Biomonitoring Program, Health and Safety Code (H&SC) sections 105440 et seq.

<sup>2</sup> The Data Summary Report is required to be issued biennially by H&SC section 105459(d).

***Biomonitoring California's initial studies have identified many chemicals, including flame retardants, pesticides, and plasticizers, in California residents.***

Among the chemicals detected by Biomonitoring California are plasticizers and other additives in consumer products (e.g., phthalates, perfluorochemicals [PFCs], pesticides, and heavy metals, such as lead and mercury). Biomonitoring California has also found persistent chemicals that have been banned, including some flame retardants that were widely used in furniture and electronics (e.g., penta- and octa-polybrominated diphenyl ethers [PBDEs], respectively) and some pesticides (e.g., DDT).

***Biomonitoring California now has the ability to measure close to 100 chemicals in people and has tested more than 700 Californians.***

Since 2007, Biomonitoring California's laboratories have made significant advances in their ability to measure chemicals in people (see Figure 1). The Program's laboratories can now analyze approximately 100 different chemicals in blood or urine (see Table 1), and are developing methods to test for additional chemicals of particular importance to California. Biomonitoring California has tested more than 700 Californians so far, and anticipates being able to test up to 1,000 people annually in the foreseeable future.

***Biomonitoring California has leveraged limited state resources through successful collaborations.***

The Program has been able to advance its laboratory capability and study diverse populations by leveraging limited state resources. To date, the Program's results have come from studies of more than 10 populations across California, including pregnant women, firefighters, residents of agricultural communities, and pre-adolescent girls. Critical to our accomplishments has been a five-year Cooperative Agreement with the federal Centers for Disease Control and Prevention (CDC), which has more than doubled the resources available for building California's biomonitoring capacity. Another essential component of the Program's progress has been our collaboration with a variety of organizations, including several campuses of the University of California, labor and management groups, and Kaiser Permanente.

## Looking forward for Biomonitoring California

- Biomonitoring California anticipates releasing more detailed findings about its project collaborations in the near future.
- Our laboratory capability and capacity are continuing to expand.
- The Program has launched a pilot study in the Central Valley with participants selected to approximately represent the adult population of that area. This pilot project will help us build capacity to produce data representative of the state's general population.
- Biomonitoring California findings will be critical for informing state programs to protect the public from harmful chemicals, making those efforts more targeted and cost-effective.

## Attachments

The attached materials provide:

- The chemicals our laboratories can currently analyze;
- The chemicals the laboratories have analyzed to date;
- How frequently we found these chemicals in California residents; and
- A summary of our project collaborations.

Based on input from the SGP and public comments submitted on March 16, 2012, these materials will be updated and used to develop the next Data Summary Report. The Data Summary Report is required to be issued biennially by the Program's enabling legislation (see H&SC section 105459 (d)).

List of Attachments (in the order they appear in this document):

- Table 1. Chemicals that Biomonitoring California Laboratories Can Measure – March 2012
- Figure 1. Chemicals that Biomonitoring California Laboratories Can Measure – Progress, 2007-2011
- Description of Biomonitoring California Project Collaborations
- Table 2. Biomonitoring California Full Project and Laboratory Collaborations
- Table 3. Initial Combined Results from Biomonitoring California Collaborations

**Table 1. Chemicals that Biomonitoring California Laboratories Can Measure – March 2012**

This table provides a list of the chemicals that Biomonitoring California can currently measure, and a brief description of the chemicals individually or by class. The table also summarizes the number of analytes in each group and whether the chemicals are analyzed in blood or urine.

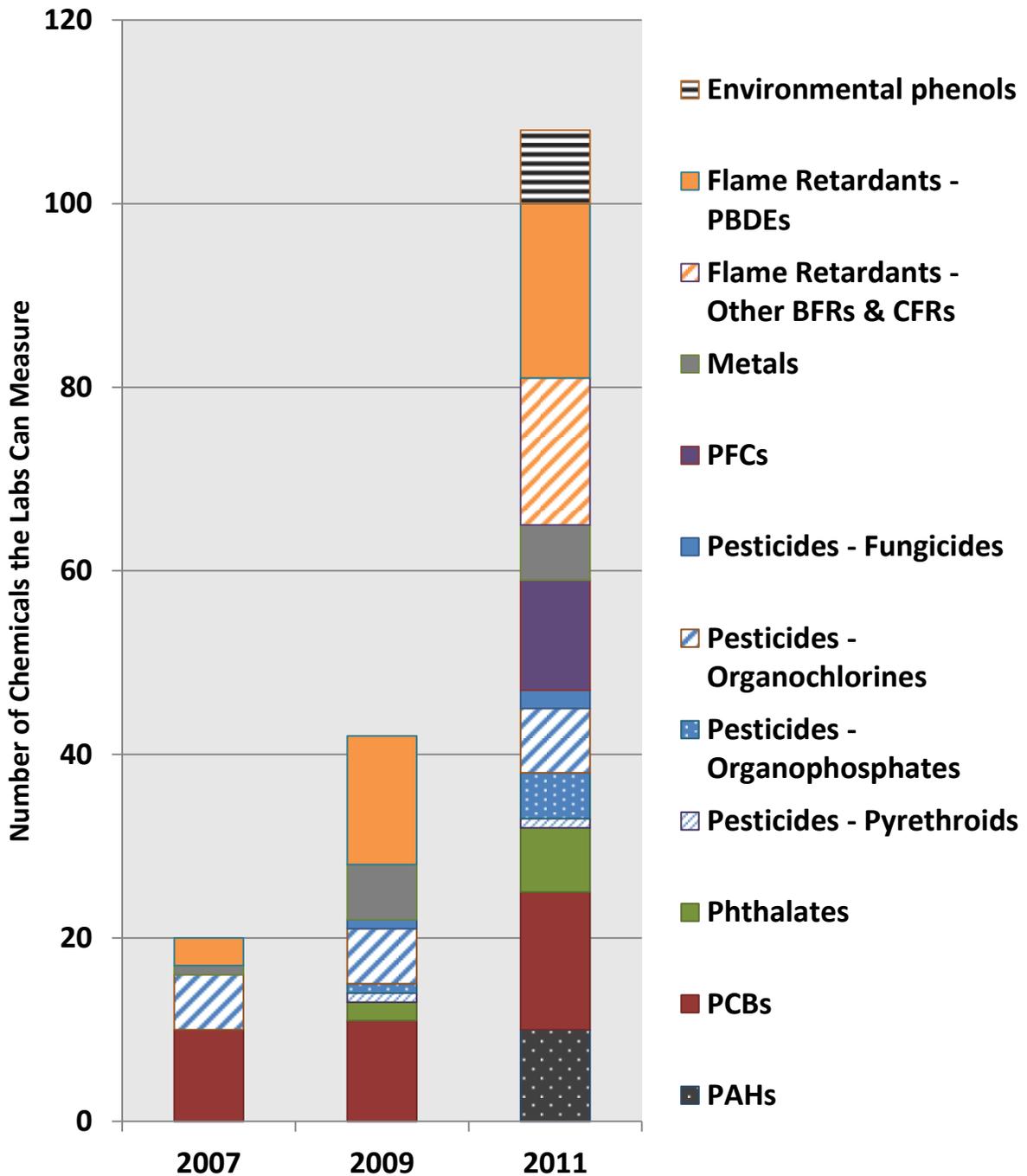
<b>Chemicals that Biomonitoring California Laboratories Can Measure – March 2012</b>		
<b>Environmental phenols</b>	Environmental phenols have a common chemical structure, so are analyzed as a group. They have a wide variety of uses, described briefly below.	<p><i>Analyzed in urine:</i></p> <p>Benzophenone-3 BPA 4-t-OP 4 parabens Triclosan</p> <p><i>Analyzed in serum:</i></p> <p>BPA Triclosan</p>
Benzophenone-3	Benzophenone-3 is a UV blocker used in sunscreens and plastics.	
Bisphenol A (BPA)	BPA is used to make protective coatings, like those inside metal food cans that prevent rust and corrosion. It is also the building block for a hard plastic called polycarbonate.	
4-t-Octylphenol (4-t-OP)	4-t-OP is used in rubber and has been found in recycled tires. 4-t-OP is also used to make ingredients for protective coatings, paints, varnishes, and detergents.	
Parabens	Parabens are widely used as preservatives in cosmetics, lotions, shampoos, deodorants, pharmaceuticals, foods, and beverages.	
Triclosan	Triclosan is used to kill bacteria. It is added to soaps and other consumer products labeled “antibacterial” or “antimicrobial.”	
<b>Flame retardants (brominated and chlorinated)</b>	Flame retardants are added to products such as furniture foam (e.g., cushions), textiles, and electronics to meet flammability standards.	<p><i>Analyzed in serum:</i></p> <p>19 PBDEs 8 hydroxy-PBDE metabolites<sup>3</sup></p>
Polybrominated diphenyl ethers (PBDEs)	Since 2006, most PBDEs have been banned in products sold in California; decaBDE is being phased out. PBDEs last a long time in the environment and people. Past biomonitoring studies have measured the world’s highest PBDE levels in Californians. PBDEs were extensively used to meet the state’s furniture flammability standards.	

<sup>3</sup> A metabolite is any substance produced by the body as it breaks down or transforms chemicals.

<b>Chemicals that Biomonitoring California Laboratories Can Measure – March 2012</b>		
Other brominated or chlorinated flame retardants (BFRs and CFRs)	BFRs and CFRs are widely used in consumer products and for industrial applications. Some are replacements for PBDEs.	<i>Analyzed in serum:</i> 15 BFRs 1 CFR
<b>Metals</b>	Metals occur in nature and are used in many industries and products.	<i>Analyzed in blood:</i> 6 metals  <i>(Methods under development for metals analyzed in urine)</i>
Arsenic	Arsenic occurs naturally in some foods and in drinking water in some geographic areas. Arsenic compounds are used as pesticides, although this use has declined considerably in recent years. One arsenic compound is used in semi-conductors.	
Cadmium	Cadmium is found in cigarette smoke, some cheap metal jewelry, nickel-cadmium batteries, and some paints and pigments.	
Lead	Lead was formerly used in paint and gasoline and is still used in many consumer products, including some dishes and pottery, and some plastic products. It is found in dust and soil in and around houses built before 1978 and at some job sites, such as painting, construction, and battery recycling.	
Manganese	Manganese is an essential nutrient found mainly in food. It can be toxic at higher exposure levels, which can occur in metalworking occupations like welding. Manganese is also a component of two fungicides widely used in California.	
Mercury	Mercury occurs naturally in much of California, and in the past was released into the environment from mining operations. It is also found in emissions from coal-burning plants. Mercury in the environment builds up in certain types of fish. It is used in silver dental fillings and fluorescent light bulbs. It has also been found in some imported skin-lightening and anti-aging creams.	
Uranium	Uranium occurs naturally in drinking water sources in some geographic areas. Natural uranium is processed for use as fuel in nuclear power plants. Depleted uranium, which is a byproduct of processing natural uranium, is used in military applications.	
<b>Perfluorochemicals (PFCs)</b>	PFCs are used to make various products resistant to oil, stains, grease, and water. Example products include: stain-resistant carpets, wrinkle-free clothing, and grease-proof food containers.	<i>Analyzed in serum:</i> 12 PFCs

<b>Chemicals that Biomonitoring California Laboratories Can Measure – March 2012</b>		
<b>Pesticides</b>	Chemicals used to control or kill pests, such as insects, fungi, and unwanted plant species.	
Fungicides	Ortho-phenylphenol (OPP) is used to control fungus on agricultural crops, such as citrus fruit. Pentachlorophenol (PCP) was used in the past mainly as a wood preservative, to control fungal rot and wood-boring insects. PCP is no longer registered for sale in California.	<i>Analyzed in urine and serum:</i> OPP PCP
Organochlorine pesticides (OCPs)	OCPs are banned in the U.S. Because they last a long time in the environment, they are still found in high-fat fish and high-fat animal and dairy products. Some OCPs are still used in other countries, including Mexico and some countries in Africa. DDT and chlordane are examples of OCPs.	<i>Analyzed in serum:</i> 7 OCPs, including metabolites and breakdown products  <i>Analyzed in urine:</i> 4 OCP metabolites
Organophosphate pesticides (OPs)	OPs are used to kill insects on agricultural crops, such as alfalfa, almonds, and cotton. Chlorpyrifos was one of the top 20 agricultural pesticides used in California in 2010. Some OPs, such as malathion, are used for landscape maintenance.	<i>Analyzed in urine:</i> 4 nonspecific metabolites of more than 20 OPs Chlorpyrifos metabolite
Pyrethroid pesticides	Pyrethroid pesticides are used to kill insects in agriculture. Two pyrethroids were in the top 100 agricultural pesticides used in California in 2010. They are also used in products for home use, including some flea control products for pets.	<i>Analyzed in urine:</i> 1 metabolite of at least 6 pyrethroids
<b>Phthalates</b>	Phthalates are added to vinyl to make it soft and flexible. Vinyl products include shower curtains, flooring, and plastic tubing. Phthalates are also in some nail polish and scented products.	<i>Analyzed in urine:</i> 6 phthalate metabolites
<b>Polychlorinated biphenyls (PCBs)</b>	PCBs were banned in the late 1970s but last a long time in the environment. They are found high-fat fish and high-fat animal and dairy products. PCBs are also found in old caulk and old fluorescent light fixtures.	<i>Analyzed in serum:</i> 15 PCBs 10 PCB metabolites
<b>Polycyclic aromatic hydrocarbons (PAHs)</b>	PAHs are formed when petroleum products are burned. They are also found in cigarette and wood smoke, and in grilled meat. PAHs occur naturally in volcanic eruptions and forest fires.	<i>Analyzed in urine:</i> 10 PAH metabolites

**Figure 1: Chemicals that Biomonitoring California Laboratories Can Measure - Progress, 2007-2011**



Abbreviations: **BFRs** - brominated flame retardants; **CFRs** - chlorinated flame retardants; **PAHs** - polyaromatic hydrocarbons; **PBDEs** - polybrominated diphenyl ethers; **PCBs** - polychlorinated biphenyls; **PFCs** - perfluorinated chemicals

## Description of Biomonitoring California Project Collaborations

Over the past five years, Biomonitoring California has collaborated with partners in two ways:

**1. Full Project Collaborations:** Biomonitoring California designed and carried out the entire study in partnership with other organizations. This includes choosing the population; recruiting participants in the study; collecting survey information and blood and urine samples; and conducting laboratory analyses; and

**2. Laboratory Collaborations:** Biomonitoring California conducted laboratory chemical analyses on blood and urine samples collected by outside partners as part of other research projects.

The following descriptions and Table 2 provide information about the individual Biomonitoring California collaborative projects.

### Full Project Collaborations

The **Biomonitoring Exposures Study (BEST)** is a collaborative effort between Biomonitoring California and the Kaiser Permanente Northern California (KPNC) Division of Research. BEST will initially measure environmental chemical exposures in about 100 adult KPNC members living in California's Central Valley. This is the first Biomonitoring California study to collect regionally representative samples with participants randomly selected across gender, age, race/ethnicity, and location. Questionnaire and medical information as well as blood and urine samples will be collected in 2011-2012. The study will be expanded to include more participants and diverse populations over the next year.

The **Firefighter Occupational Exposures (FOX) Project** is a study of environmental chemical exposures in firefighters conducted in partnership with the University of California (UC) Irvine's Center for Occupational and Environmental Health and the Orange County Fire Authority. Questionnaire information and blood and urine samples were collected in 2010-2011 from 101 male and female firefighters in Orange County, California. Firefighters were chosen because they are likely to be exposed to toxic chemicals as a result of their profession.

The **Maternal and Infant Environmental Exposure Project (MIEEP)**, also known as the Chemicals in our Bodies Project, is a collaborative effort of Biomonitoring California, the UC San Francisco Program on Reproductive Health and the Environment (UCSF/PRHE), and the UC Berkeley School of Public Health. The project measures chemical exposures in 92 pregnant women and their newborns. English- and Spanish-speaking pregnant women were recruited at San Francisco General Hospital in 2010-2011. Urine samples and questionnaire information were collected in the third trimester of pregnancy, and maternal and umbilical cord blood samples were collected at delivery.

## Laboratory Collaborations

The **California Teachers Study** is a large, multi-institutional, statewide cohort study conducted by the Cancer Prevention Institute of California, the City of Hope, the University of Southern California, and UC Irvine to study factors influencing women's health among active and retired female school teachers and administrators in California. In a nested case-control study focusing on links between chemical exposures and breast cancer, Biomonitoring California laboratories are conducting analyses of persistent organic pollutants (PCBs, OCPs, PBDEs, and new BFRs) and PFCs in serum samples from approximately 1,360 cases (with breast cancer) and 1,360 controls (without breast cancer).

The **Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS)**, a study conducted by researchers at UC Berkeley, is following a cohort of children in the agricultural communities of the Salinas Valley. Their mothers were enlisted while pregnant, and the children have been followed through age 12 to learn more about the potential impact of chemical and other environmental exposures on children's health. Biomonitoring California laboratories analyzed phthalates in urine samples from a subset of participants.

The **Cohort of Young Girls' Nutrition, Environment, and Transitions (CYGNET)** study is conducted by the KPNC Division of Research, the California Department of Public Health, and Zero Breast Cancer, as part of the Breast Cancer and the Environment Research Program. CYGNET identifies chemical exposures in girls in the San Francisco Bay Area and assesses the relationship of these exposures to possible health effects, such as timing of puberty. Biomonitoring California laboratories conducted analysis of metals in blood samples from a subset of CYGNET participants.<sup>4</sup>

The **Environmental Chemistry Laboratory Pilot Study**<sup>5</sup> is an ongoing study that recruits volunteers in order to refine procedures used by Biomonitoring California (sample collection, shipping, and laboratory analyses). Biomonitoring California collects and analyzes all samples for this study. Some of these data have been included in a publication tracing levels of perfluorochemicals (PFCs) in California women over the last 50 years.<sup>6</sup>

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<sup>4</sup> 1358 - Heavy metals in blood of pre- and peri-pubertal girls in California, by demographic characteristics - (P-0453), Gayle Windham, Dina Dobraca, Ryszard Gajek, Frank Barley, Cassandra Aldsworth, Lawrence Kushi. 2011. Abstracts of the 23rd Annual Conference of the International Society of Environmental Epidemiology (ISEE). September 13-16, 2011, Barcelona, Spain. Environ Health Perspect :- <http://dx.doi.org/10.1289/ehp.isee2011>

<sup>5</sup> There were no external project collaborators on this study. The entire study was conducted by Biomonitoring California.

<sup>6</sup> Wang M, Park J-S, Petreas M. Temporal changes in the levels of perfluorinated compounds in California women's serum over the past 50 Years. Environmental Science and Technology 45, 7510-7516. 2011

**Markers of Autism Risk in Babies–Learning Early Signs (MARBLES)** is a longitudinal study, conducted by researchers at UC Davis, of pregnant women who previously had a child diagnosed with an autism spectrum disorder. The study is investigating possible biological and environmental exposures during pregnancy and after delivery as well as other risk factors that may contribute to the development of autism. Biomonitoring California analyzed phthalates in urine samples from a subset of study participants.

The **Pesticide Drift 2 Study** assessed exposure from pesticide drift among adults and children in a rural agricultural community in Tulare County. The study was a collaboration with the California Environmental Health Tracking Program, Pesticide Action Network of North America, El Quinto Sol, and Commonweal. Biomonitoring California analyzed breakdown products of the pesticide chlorpyrifos in urine samples collected as part of this study.

The **UCSF Pilot Study of Second Trimester Pregnant Women** collected samples from 25 pregnant women seeking care at San Francisco General Hospital. The study population consisted of ethnically diverse and predominately low-income women in their second trimesters of pregnancy. This study investigated various relationships, including associations between PBDE exposures and measures of thyroid function during the second trimester of pregnancy. This study was a collaboration between Biomonitoring California and UCSF/PRHE. Biomonitoring California laboratories analyzed the serum samples for persistent organic pollutants (PCBs, pesticides, PBDEs, and PFCs) and their metabolites (hydroxy-PCBs and hydroxy-PBDEs). Results from the PBDE and hydroxy- metabolites part of this study have already been published.<sup>7</sup>

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<sup>7</sup> Zota A.R., Park J.S., Wang Y., Petreas M., Zoeller R.T., Woodruff T.J. Polybrominated diphenyl ethers (PBDEs), hydroxylated PBDEs (OH-PBDEs), and measures of thyroid function in second trimester pregnant women in California. *Environmental Science & Technology* 2011 45(18): 7896 - 905. (<http://www.ncbi.nlm.nih.gov/pubmed/21830753>)

**Table 2. Biomonitoring California Full Project and Laboratory Collaborations**

Study Name	Number of Participants	Population	Catchment Area	Chemicals Being Biomonitored <sup>8</sup>												Dates Samples Collected
				PBDEs	Other BFRs & CFRs	Cadmium	Lead	Manganese	Mercury	PFCs	Pesticides	Phenols, e.g., BPA & Triclosan	Phthalates	PCBs	PAHs	
<b>Full Project Collaborations</b>																
Biomonitoring Exposures Study (BEST)	Approximately 100	Adults	Central Valley	X	X	X	X	X	X	X	X	X	X	X	X	2011-2012
Firefighter Occupational Exposures (FOX) Project	101	Firefighters	Orange County	X	X	X	X	X	X	X	X	X	X	X	X	2010-2011
The Maternal and Infant Environmental Exposure Project (MIEEP)	92 maternal infant pairs	Pregnant women and their babies	San Francisco	X	X	X	X		X	X	X	X	X	X	X	2010-2011
<b>Laboratory Collaborations</b>																
California Teachers Study	Approximately 2,720	Female professional school employees	Northern California	X	X						X	X			X	2010-2013
The Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) Study	49	5-year-old children	Salinas Valley											X		2005-2006

<sup>8</sup> For full project collaborations, this list represents all chemicals being biomonitored in study participants. For laboratory collaborations, this list represents only the chemicals that were tested by Biomonitoring California laboratories.

Study Name	Number of Participants	Population	Catchment Area	Chemicals Being Biomonitored <sup>8</sup>											Dates Samples Collected		
				PBDEs	Other BFRs & CFRs	Cadmium	Lead	Manganese	Mercury	PFCs	Pesticides	Phenols, e.g., BPA & Triclosan	Phthalates	PCBs		PAHs	
Cohort of Young Girls' Nutrition, Environment, and Transitions (CYGNET) Study	351	Girls 6-8 years old	San Francisco Bay Area			X	X	X	X								2005-2007
Environmental Chemistry Lab Pilot Study	50	Adults	California	X	X					X	X				X		2008-ongoing
Markers of Autism Risk in Babies-Learning Early Signs (MARBLES) Study	15	Pregnant women who have a biological child with autism spectrum disorder	Northern California										X				2007-2008
Pesticide Drift 2 Study	34	Farmworkers and their children	Tulare County								X						2009-2010
UCSF Pilot Study of Second Trimester Pregnant Women	25	Pregnant women	Northern California	X						X	X				X		2008-2009

### **Table 3. Initial Combined Results from Biomonitoring California Collaborations**

Table 3 displays the percentage of people in which the chemicals were found (known as the detection frequency). The detection frequency does not indicate the level of a chemical that is measured. Simply finding a chemical in a person's blood or urine does not provide information on possible health effects.

This table combines results from eight individual studies. It shows the chemicals Biomonitoring California has found so far in California residents who have been tested.<sup>9</sup> These detection frequencies are not necessarily representative of chemicals in the state's population as a whole.

Biomonitoring California's collaborations are in various stages, from data collection to completed projects. Every study is being analyzed separately, and the results from each will be reported when they are available. These later reports will include information on the actual levels measured and results for more chemicals.

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<sup>9</sup> Additional analyses are underway on samples from Biomonitoring California projects that are still in progress. For more information on which chemicals are being analyzed in the different projects, see Table 2.

**Table 3. Initial Combined Results from Biomonitoring California Collaborations**

Chemical	Study <sup>10 &amp; 11</sup>	Number of People	Detection Frequency <sup>12</sup>
<b>Flame Retardants (brominated and chlorinated)</b>			
<b>Polybrominated Diphenyl Ethers (PBDEs)</b>			
BDE 28	D,F	102	56%
BDE 47	D,E,F	136	91%
BDE 66	D,F	102	7%
BDE 85	D,F	102	25%
BDE 99	D,E,F	135	70%
BDE 100	D,F	102	91%
BDE 153	D,E,F	135	90%
BDE 154	D,F	102	17%
BDE 183	D,F	102	5%
BDE 197	D,F	102	36%
BDE 206	D,F	102	4%
BDE 207	D,F	102	33%
BDE 208	D,F	102	12%
BDE 209	D,F	102	46%
<b>Hydroxy-PBDEs (metabolites of PBDEs)</b>			
4'-Hydroxy-BDE 17	F	24	58%
5-Hydroxy-BDE 47	F	24	83%
6-Hydroxy-BDE 47	F	24	92%
4'-Hydroxy-BDE 49	F	24	50%
<b>Metals</b>			
Cadmium	A,B,D	529	61%
Lead	A,B,D	529	100%
Manganese	A,B	452	100% <sup>13</sup>
Mercury	A,B,D	529	97%

<sup>10</sup> Studies: (A) CYGNET; (B) FOX; (C) MARBLES; (D) MIEEP, maternal results only (cord blood results were excluded from the combined results); (E) Environmental Chemistry Lab Pilot Study; (F) UCSF Pilot Study of Second Trimester Pregnant Women; (G) Pesticide Drift 2 Study; (H) CHAMACOS

<sup>11</sup> For more information on these studies, see Description and Table of Biomonitoring Project Collaborations, pages 9-13.

<sup>12</sup> Detection frequency is the percentage of people who had measurable levels of the chemicals out of the total number of people in the projects. If someone had multiple measurements, then only the first measurement (chronologically) was used to calculate the detection frequency.

<sup>13</sup> Manganese is an essential nutrient, so the 100% detection frequency of manganese was expected.

Chemical	Study <sup>10 &amp; 11</sup>	Number of People	Detection Frequency <sup>12</sup>
<b>Perfluorochemicals (PFCs)</b>			
2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid	B,D,F	203	49%
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	B,D,F	203	99%
Perfluorobutane sulfonic acid	B,D,F	203	4%
Perfluorodecanoic acid	B,D,F	203	72%
Perfluorododecanoic acid	B,D,F	203	1%
Perfluoroheptanoic acid	B,D,F	203	58%
Perfluorohexane sulfonic acid	B,E,F	137	100%
Perfluorononanoic acid	B,D,F	203	100%
Perfluorooctane sulfonamide	B,D,F	203	83%
Perfluorooctane sulfonic acid (PFOS)	B,D,E,F	236	100%
Perfluorooctanoic acid (PFOA)	B,D,E,F	236	86%
Perfluoroundecanoic acid	B,D,F	203	97%
<b>Pesticides</b>			
<b>Organochlorine Pesticides</b>			
2,4'-Dichlorodiphenyltrichloroethane (DDT)	D,E	98	12%
4,4'-DDT	D,E,F	123	28%
4,4'-Dichlorodiphenyldichloroethene (DDE) <sup>14</sup>	D,E,F	136	99%
beta-Hexachlorocyclohexane (b-HCH)	D,E,F	123	65%
Hexachlorobenzene (HCB)	D,E,F	135	96%
Oxychlordan <sup>15</sup>	D,E,F	136	66%
trans-Nonachlor <sup>16</sup>	D,E,F	136	88%
<b>Organophosphate Insecticides</b>			
3,5,6-Trichloro-2-pyridinol <sup>17</sup>	G	34	94%
<b>Phthalates</b>			
Mono-butyl phthalate <sup>18</sup>	C,H	64	100%
Mono-ethyl phthalate <sup>19</sup>	C,H	64	100%

<sup>14</sup> DDE is a metabolite and environmental breakdown product of DDT.

<sup>15</sup> Oxychlordan is a metabolite and environmental breakdown product of chlordan.

<sup>16</sup> t-Nonachlor was a component of the commercial chlordan mixture.

<sup>17</sup> 3,5,6-Trichloro-2-pyridinol is a metabolite of chlorpyrifos.

<sup>18</sup> Mono-butyl phthalate is a metabolite of benzylbutyl phthalate and dibutyl phthalate.

<sup>19</sup> Mono-ethyl phthalate is a metabolite of diethyl phthalate.

<b>Chemical</b>	<b>Study<sup>10 &amp; 11</sup></b>	<b>Number of People</b>	<b>Detection Frequency<sup>12</sup></b>
<b>Polychlorinated Biphenyls (PCBs)</b>			
PCB 66	D,E,F	123	14%
PCB 74	D,E,F	136	38%
PCB 99	D,E,F	136	35%
PCB 101	D,F	102	14%
PCB 118	D,E,F	136	53%
PCB 138	D,E,F	136	89%
PCB 153	D,E,F	136	93%
PCB 156	D,F	102	19%
PCB 170	D,E,F	136	64%
PCB 180	D,E,F	125	92%
PCB 187	D,E,F	136	51%
PCB 194	D,E,F	136	32%
PCB 203	D,E	111	32%