***Attachment 8***

***Laboratory Assessments***

**Attachment 8 – NHANES Laboratory Assessments**

**Attachment 8a - Laboratory Analytes by Age Group**

| **Test Name** | **Sample** | **Matrix** | |
| --- | --- | --- | --- |
| **Ages 1-2** |  |  | |
| Complete Blood Count | Full | Whole blood | |
| Erythrocyte Folate | Full | Whole blood | |
| Hepatitis B Surface Antibody (Anti-HBs) 2 years and older | Full | Serum | |
| Serum Folate | Full | Serum | |
| Vitamin D | Full | Serum | |
| **Ages 3-5** |  |  | |
| Complete Blood Count | Full | Whole blood | |
| Erythrocyte Folate | Full | Whole blood | |
| Fatty Acids (polyunsaturated, monounsaturated, and saturated) | Full | Serum | |
| Hepatitis Profile\*\* | Full | Serum | |
| Serum Folate | Full | Serum | |
| Vitamin D | Full | Serum | |
| **Ages 6-11** |  |  | |
| Albumin/Creatinine | Full | Urine | |
| Caffeine | One-third | Urine | |
| Cholesterol (Total)/ High Density Lipoprotein Cholesterol (HDL) | Full | Serum | |
| Complete Blood Count | Full | Whole blood | |
| Estradiol | Full | Serum | |
| Erythrocyte Folate | Full | Whole blood | |
| Fluoride, plasma | Full | Plasma EDTA | |
| Fluoride, water | Full | Water | |
| Fatty Acids (polyunsaturated, monounsaturated, and saturated) | Full | Plasma EDTA | |
| Hepatitis Profile\*\* | Full | Serum | |
| Serum Folate | Full | Serum | |
| Sex hormone binding globin | Full | Serum | |
| Testosterone | Full | Serum | |
| Tissue transglutaminase (TTG)/Endomysial antibody (EMA) | Full | Serum | |
| Urine flow rate | Full | Urine | |
| Vitamin D | Full | Serum | |
| **Ages 12-19** |  |  | |
| Albumin/Creatinine | Full | Urine | |
| Biochemistry Profile\* | Full | Serum | |
| Caffeine | One-third | Urine | |
| Chlamydia trachomatis (14-19 years) | Full | Urine | |
| Cholesterol (Total)/ High Density Lipoprotein Cholesterol (HDL) | Full | Serum | |
| Complete Blood Count | Full | Whole blood | |
| Erythrocyte Folate | Full | Whole blood | |
| Estradiol | Full | Serum | |
| Fluoride, plasma | Full | Plasma EDTA | |
| Fluoride, water | Full | Water | |
| Glucose (Oral Glucose Tolerance Test) | One-half | Plasma Na2F | |
| Glucose, fasting | One-half | Plasma Na2F | |
| Glycohemoglobin | Full | Whole blood | |
| Fatty Acids (polyunsaturated, monounsaturated, and saturated) | One-half | Serum | |
| Hepatitis Profile\*\* | Full | Serum | |
| Herpes Simplex Virus (HSV) (14-19 years) | Full | Serum | |
| Human Immunodeficiency Virus Antibody (18-19 years) | Full | Serum | |
| Human Papilloma Virus (14-19 years) | Full | Serum | |
| Human Papilloma Virus (Females and Males 14-19 years) | Full | Swab | |
| Human Papilloma Virus (14-19 years) | Full | Rinse | |
| Methylmalonic acid (MMA) (19 years) | Full | Serum | |
| Insulin | One-half | Serum | |
| Serum Folate | Full | Serum | |
| Sex hormone binding globulin | Full | Serum | |
| Testosterone | Full | Serum | |
| Tissue transglutaminase (TTG)/Endomysial antibody (EMA) | Full | Serum | |
| Triglycerides/Low Density Lipoprotein Cholesterol/Apolipoprotein B | One-half | Serum | |
| Trichomonas vaginalis (14-19 years) | Full | Urine | |
| Urine flow rate | Full | Serum | |
| Vitamin D | Full | Serum | |
| Vitamin B12 (19+ years) | Full | Serum | |
| **Ages 20 and older** |  | |  |
| Albumin/Creatinine | Full | | Urine |
| Biochemistry Profile\* | Full | | Serum |
| Caffeine | One-third | | Urine |
| Chlamydia trachomatis (20-39 years) | Full | | Urine |
| Cholesterol (Total)/ High Density Lipoprotein Cholesterol (HDL) | Full | | Serum |
| Complete Blood Count | Full | | Whole blood |
| Erythrocyte Folate | Full | | Whole blood |
| Estradiol | Full | | Serum |
| Glucose (Oral Glucose Tolerance Test) | One-half | | Plasma Na2F |
| Glucose, fasting | One-half | | Plasma Na2F |
| Glycohemoglobin | Full | | Whole blood |
| Fatty Acids (polyunsaturated, monounsaturated, and saturated) | One-half | | Serum |
| Hepatitis Profile \*\* | Full | | Serum |
| Herpes Simplex Virus (HSV) (20-49 years) | Full | | Serum |
| Human Immunodeficiency Virus antibody (20-59 years) | Full | | Serum |
| Human Papilloma Virus (20-59 years) | Full | | Serum |
| Human Papilloma Virus (Females and Males 20-59 years) | Full | | Swab |
| Human Papilloma Virus (20-69 years) | Full | | Rinse |
| Insulin | One-half | | Serum |
| Methylmalonic acid (20+ years) | Full | | Serum |
| Serum Folate | Full | | Serum |
| Sex hormone binding globulin | Full | | Serum |
| Testosterone | Full | | Serum |
| Tissue transglutaminase (TTG)/Endomysial antibody (EMA) | Full | | Serum |
| Triglycerides/Low Density Lipoprotein Cholesterol/Apolipoprotein B | One-half | | Serum |
| Trichomonas vaginalis (20-59 years) | Full | | Urine |
| Urine flow rate | Full | | Urine |
| Vitamin B12 (19+ years) | Full | | Serum |
| Vitamin D | Full | | Serum |
| **\*Biochemistry Profile** |  | |  |
| Albumin |  | |  |
| Alkaline phosphatase |  | |  |
| Aspartate aminotransferase (AST) |  | |  |
| Alanine aminotransferase (ALT) |  | |  |
| Blood urea nitrogen (BUN) |  | |  |
| Bicarbonate (HCO3) |  | |  |
| Total calcium |  | |  |
| Total cholesterol |  | |  |
| Chloride |  | |  |
| CPK |  | |  |
| Creatinine |  | |  |
| Globulin |  | |  |
| Glucose |  | |  |
| v-glutamyltransferase (GGT) |  | |  |
| Iron |  | |  |
| Potassium |  | |  |
| Lactate dehydrogenase (LDH) |  | |  |
| Sodium |  | |  |
| Osmolality |  | |  |
| Phosphorus |  | |  |
| Total Bilirubin |  | |  |
| Total protein |  | |  |
| Triglycerides |  | |  |
| Uric acid |  | |  |
| \*\***Hepatitis Profile** |  | |  |
| Hepatitis A antibody (Anti-HAV) |  | |  |
| Hepatitis B Core antibody (Anti-HBc) |  | |  |
| Hepatitis B Surface Antibody (Anti-HBs) |  | |  |
| Hepatitis B Surface Antigen (HbsAg) |  | |  |
| Hepatitis C Antibody (Anti-HCV) |  | |  |
| Hepatitis C HCV genotype |  | |  |
| Hepatitis C Ribonucleic Acid (HCV-RNA) |  | |  |
| Anti-HCV Supplemental Test (RIBA) |  | |  |
| Hepatitis D antibody (anti-HDV) |  | |  |
| Hepatitis E antibody (anti-HEV) |  | |  |

**Attachment 8 – NHANES Laboratory Assessments**

**Attachment 8b - Laboratory Analytes by Survey Year**

All urine based and packed cells analyses are done on a 1/3 sample of participants ages 6 and older unless otherwise noted. All blood based (whole blood, serum, plasma) analyses are done on a 1/3 sample of participants ages 12 and older unless otherwise noted.

| **Chemical / Metabolite Name** | **Matrix** | | **09-10** | **11-12** | | **13-14** |
| --- | --- | --- | --- | --- | --- | --- |
| **Tobacco Biomarkers: Cotinine and Nicotine Analogs** |  | |  |  | |  |
| Cotinine0 | serum | | ● | ● | | ● |
| Cotinine | urine | |  |  | | ● |
| Anabasine | urine | |  |  | | ● |
| Anatabine | urine | |  |  | | ● |
| Cotinine-n-oxide | urine | |  |  | | ● |
| Hydroxycotinine | serum | |  |  | | ● |
| Hydroxycotinine | urine | |  |  | | ● |
| Norcotinine | urine | |  |  | | ● |
| Menthol | urine | |  |  | | ● |
| Nicotine | urine | |  |  | | ● |
| Nicotine-1'N-oxide | urine | |  |  | | ● |
| 1-(3-Pyridyl)-1-butanol-4-carboxylic Acid | urine | |  |  | | ● |
| 1-(3-Pyridyl)-1-butanone-4-carboxylic Acid | urine | |  |  | | ● |
| Nornicotine | urine | |  |  | | ● |
| **Tobacco Biomarkers: Aldehydes** |  | |  |  | |  |
| Acetaldehyde | serum | |  |  | | ● |
| Acrolein | serum | |  |  | | ● |
| Benzaldehyde | serum | |  |  | | ● |
| Butyraldehyde | serum | |  |  | | ● |
| Crotonaldehyde | serum | |  |  | | ● |
| Decanal | serum | |  |  | | ● |
| Furaldehyde | serum | |  |  | | ● |
| Heptanal | serum | |  |  | | ● |
| n-Hexanal | serum | |  |  | | ● |
| Isovaleraldehyde | serum | |  |  | | ● |
| Nonanal | serum | |  |  | | ● |
| 2-Nonenal | serum | |  |  | | ● |
| Octanal | serum | |  |  | | ● |
| o-Tolualdehyde | serum | |  |  | | ● |
| Pentanal | serum | |  |  | | ● |
| Propionaldehyde | serum | |  |  | | ● |
| **Tobacco Biomarkers: Aromatic Amines** |  | |  |  | |  |
| 1-Aminonaphthalene | urine | |  |  | | ● |
| 2-Aminonaphthalene | urine | |  |  | | ● |
| 2-Aminobiphenyl | urine | |  |  | | ● |
| 3-Aminobiphenyl | urine | |  |  | | ● |
| 4-Aminobiphenyl | urine | |  |  | | ● |
| Anisidine | urine | |  |  | | ● |
| Benzidine | urine | |  |  | | ● |
| 2,6-Dimethylaniline | urine | |  |  | | ● |
| o-Toluidine | urine | |  |  | | ● |
| p-Toluidine | urine | |  |  | | ● |
| Quinoline | urine | |  |  | | ● |
| **Tobacco Biomarkers: Heterocyclic Amines** |  | |  |  | |  |
| Norharman | urine | |  |  | | ● |
| Harman | urine | |  |  | | ● |
| 3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole (Trp-P-1) | urine | |  |  | | ● |
| 1-Methyl-3-amino-5H-pyrido[4,3-b]indole (Trp-P-2) | urine | |  |  | | ● |
| 2-Amino-3-methyl-9H-pyriodo[2,3-b]indole (MeA-α-C) | urine | |  |  | | ● |
| 2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (Ph1P) | urine | |  |  | | ● |
| 2-Amino-9H-pyrido[2,3-b]indole (A-α-C) | urine | |  |  | | ● |
| 2-Amino-3-methylimidazo[4,5-f]quinoline (IQ) | urine | |  |  | | ● |
| 2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole  (Glu-P1) | urine | |  |  | | ● |
| 2-Aminodipyrido[1,2-a:3',2'-d] imidazole (GLU-P2) | urine | |  |  | | ● |
| **Tobacco Biomarkers: TSNAs** |  | |  |  | |  |
| 4-(Methylnitrosamino)-1-(3-pyridyl)-1-Butanol (NNAL) 1 | urine | | ● | ● | | ● |
| N'-Nitrosanatabine (NAT) 1 | urine | |  |  | | ● |
| N'-Nitrosanabasine (NAB) 1 | urine | |  |  | | ● |
| 4-(N-methylnitrosoamino)-4-(3-pyridyl) butanal (NNA) 1 | urine | |  |  | | ● |
| 4-(Methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK) 1 | urine | |  |  | | ● |
| N'-Nitrosonornicotine (NNN) 1 | urine | |  |  | | ● |
| **Tobacco Biomarkers: N-Nitrosamines** |  | |  |  | |  |
| N-Nitrosodiethylamine (NDEA) | urine | |  |  | | ● |
| N-nitrosodimethylamine (NDMA) | urine | |  |  | | ● |
| N-Nitrosoethylmethylamine (NMEA) | urine | |  |  | | ● |
| N-nitrosomorpholine (NMOR) | urine | |  |  | | ● |
| N-Nitrosopiperidine (NPIP) | urine | |  |  | | ● |
| N-Nitrosopyrrolidine (NPYR) | urine | |  |  | | ● |
| **Metals** |  | |  |  | |  |
| Lead2 | whole blood | | ● | ● | | ● |
| Lead | urine | | ● | ● | | ● |
| Cadmium2 | whole blood | | ● | ● | | ● |
| Cadmium | urine | | ● | ● | | ● |
| Manganese2 | whole blood | |  | ● | | ● |
| Selenium2 | whole blood | |  | ● | | ● |
| Mercury (total) 2 | whole blood | | ● | ● | | ● |
| Mercury (ethyl) 2 | whole blood | |  | ● | | ● |
| Mercury (methyl) 2 | whole blood | |  | ● | | ● |
| Mercury (inorganic) 2 | whole blood | | ● | ● | | ● |
| Mercury | urine | | ● | ● | | ● |
| Iodine | urine | | ● | ● | | ● |
| Arsenic (total) | urine | | ● | ● | | ● |
| Arsenous (III) acid | urine | | ● | ● | | ● |
| Arsenic (V) acid | urine | | ● | ● | | ● |
| Monomethylarsonic acid | urine | | ● | ● | | ● |
| Dimethylarsinic acid | urine | | ● | ● | | ● |
| Arsenobetaine | urine | | ● | ● | | ● |
| Arsenocholine | urine | | ● | ● | | ● |
| Trimethylarsine oxide | urine | | ● | ● | | ● |
| Antimony | urine | | ● | ● | | ● |
| Barium | urine | | ● | ● | | ● |
| Cesium | urine | | ● | ● | | ● |
| Cobalt | urine | | ● | ● | | ● |
| Manganese | urine | |  | ● | | ● |
| Molybdenum | urine | | ● | ● | | ● |
| Strontium | urine | |  | ● | | ● |
| Tin | urine | |  | ● | | ● |
| Thallium | urine | | ● | ● | | ● |
| Tungsten | urine | | ● | ● | | ● |
| Uranium | urine | | ● | ● | | ● |
| Copper3 | serum | |  | ● | | ● |
| Selenium3 | serum | |  | ● | | ● |
| Zinc3 | serum | |  | ● | | ● |
| **Phthalates and Phthalate Alternatives** |  | |  |  | |  |
| Mono-ethyl phthalate | urine | | ● | ● | | ● |
| Mono-n-butyl phthalate | urine | | ● | ● | | ● |
| Mono-iso-butyl phthalate | urine | | ● | ● | | ● |
| Mono-benzyl phthalate | urine | | ● | ● | | ● |
| Mono-2-ethylhexyl phthalate | urine | | ● | ● | | ● |
| Mono-(2-ethyl-5-oxohexyl) phthalate | urine | | ● | ● | | ● |
| Mono-(2-ethyl-5-hydroxyhexyl) phthalate | urine | | ● | ● | | ● |
| Mono-(3-carboxypropyl) phthalate | urine | | ● | ● | | ● |
| Mono-(2-ethyl-5-carboxypentyl) phthalate | urine | | ● | ● | | ● |
| Mono-(2,6-dimethyl-6-carboxyhexyl) phthalate | urine | | ● | ● | | ● |
| Mono-(2,7-dimethyl-7-carboxyheptyl) phthalate | urine | | ● | ● | | ● |
| Cyclohexane 1,2-dicarboxylic acid, mono hydroxyisononyl ester (MINCH) | urine | |  | ● surplus | | ● |
| **Polycyclic Aromatic Hydrocarbons** |  | |  |  | |  |
| 2-Hydroxyfluorene | urine | | ● | ● | | ● |
| 3-Hydroxyfluorene | urine | | ● | ● | | ● |
| 9-Hydroxyfluorene | urine | | ● | ● | | ● |
| 1-Hydroxyphenanthrene | urine | | ● | ● | | ● |
| 2-Hydroxyphenanthrene | urine | | ● | ● | | ● |
| 3-Hydroxyphenanthrene | urine | | ● | ● | | ● |
| 4-Hydroxyphenanthrene | urine | | ● | ● | | ● |
| 1-Hydroxypyrene | urine | | ● | ● | | ● |
| 1-Hydroxynapthalene (1-Naphthol) | urine | | ● | ● | | ● |
| 2-Hydroxynapthalene (2-Naphthol) | urine | | ● | ● | | ● |
| **Organophosphate Insecticides:  Dialkyl Phosphate Metabolites** |  | |  |  | |  |
| Dimethylphosphate | urine | | ● | ● | | ● |
| Dimethylthiophosphate | urine | | ● | ● | | ● |
| Dimethyldithiophosphate | urine | | ● | ● | | ● |
| Diethylphosphate | urine | | ● | ● | | ● |
| Diethylthiophosphate | urine | | ● | ● | | ● |
| Diethyldithiophosphate | urine | | ● | ● | | ● |
| **Organophosphate Insecticides: Specific Pesticides and Metabolites** |  | |  |  | |  |
| Malathion dicarboxylic acid | urine | | ● | ● | | ● |
| 3,5,6-Trichloro-2-pyridinol | urine | | ● | ● | | ● |
| 2-Isopropyl-4-methyl-6-hydroxypyrimidine | urine | | ● | ● | | ● |
| para-Nitrophenol | urine | | ● | ● | | ● |
| **Pyrethroid Pesticides** |  | |  |  | |  |
| cis-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid | urine | | ● | ● | | ● |
| trans-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid | urine | | ● | ● | | ● |
| 3-Phenoxybenzoic acid | urine | | ● | ● | | ● |
| 4-Fluoro-3-phenoxybenzoic acid | urine | | ● | ● | | ● |
| cis-3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid | urine | | ● | ● | | ● |
| **Organochlorine Pesticides** |  | |  |  | |  |
| Hexachlorobenzene | serum | | Pool | Pool | |  |
| *beta*-Hexachlorocyclohexane | serum | | Pool | Pool | |  |
| *gamma*-Hexachlorocyclohexane | serum | | Pool | Pool | |  |
| *p,p'-*DDT | serum | | Pool | Pool | |  |
| *p,p'*-DDE | serum | | Pool | Pool | |  |
| Oxychlordane | serum | | Pool | Pool | |  |
| *trans*-Nonachlor | serum | | Pool | Pool | |  |
| Mirex | serum | | Pool | Pool | |  |
| **Other Pesticides** |  | |  |  | |  |
| N,N-diethyl-3-methylbenzamide (DEET) | urine | | ● | ● | | ● |
| N-ethyl-3-methylbenzamide (Desethyl DEET) | urine | | ● | ● | | ● |
| N,N-diethyl-3-hydroxymethylbenzamide (Desethyl hydroxy DEET) | urine | | ● | ● | | ● |
| 2,5-Dichlorophenol | urine | | ● | ● | | ● |
| **Other Herbicides** |  | |  |  | |  |
| 2,4,5-Trichlorophenoxyacetic acid | urine | | ● | ● | | ● |
| 2,4-Dichlorophenoxyacetic acid | urine | | ● | ● | | ● |
| 2,4-Dichlorophenol | urine | | ● | ● | | ● |
| **Halogenated Phenolic Compounds** |  | |  |  | |  |
| 2,4,5-Trichlorophenol | urine | | ● | ● | |  |
| 2,4,6-Trichlorophenol | urine | | ● | ● | |  |
| Pentachlorophenol | serum | | ● | ● | | ● |
| 5-Chloro-2-(2,4-dichlorophenoxy)-phenol (Triclosan) | serum | | ● | ● | |  |
| **Perfluorinated Compounds** |  | |  |  | |  |
| Perfluorooctanoic acid | serum | | ● | ● | | ● |
| Perfluorooctane sulfonic acid | serum | | ● | ● | | ● |
| Perfluorohexane sulfonic acid | serum | | ● | ● | | ● |
| 2-(N-Methyl-perfluorooctane sulfonamido) acetic acid | serum | | ● | ● | | ● |
| Pefluorodecanoic acid | serum | | ● | ● | | ● |
| Perfluorobutane sulfonic acid | serum | | ● | ● | | ● |
| Perfluorononanoic acid | serum | | ● | ● | | ● |
| Perfluoroundecanoic acid | serum | | ● | ● | | ● |
| **Environmental Phenols** |  | |  |  | |  |
| Bisphenol A | urine | | ● | ● | | ● |
| Benzophenone-3 (2-Hydroxy-4-methoxybenzophenone) | urine | | ● | ● | | ● |
| **Antiseptics** |  | |  |  | |  |
| Triclocarban (TCC) | urine | |  | ● | | ● |
| Triclosan (2,4,4’-Trichloro-2’-hydroxyphenyl ether) | urine | | ● | ● | | ● |
| Methyl paraben | urine | | ● | ● | | ● |
| Ethyl paraben | urine | | ● | ● | | ● |
| Propyl paraben | urine | | ● | ● | | ● |
| Butyl paraben | urine | | ● | ● | | ● |
| **Polychlorinated Dibenzo-*p*-dioxins and Dibenzofurans** |  | |  |  | |  |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-*p*-dioxin (OCDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin (HpCDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin (HxCDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin (PeCDD) | serum | | Pool | Pool | | Pool |
| 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) | serum | | Pool | Pool | | Pool |
| 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) | serum | | Pool | Pool | | Pool |
| 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) | serum | | Pool | Pool | | Pool |
| 2,3,7,8-Tetrachlorodibenzofuran (TCDF) | serum | | Pool | Pool | | Pool |
| **Polybrominated Dibenzo-*p*-dioxins and Dibenzofurans** |  | |  |  | |  |
| 2,3,7,8-Tetrabromorodienzo-*p*-dioxin (TBDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,7,8-Pentabromodibenzo-*p*-dioxin (PeBDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,7,8-Hexabromorodibenzo-*p*-dioxin (HxBDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,6,7,8-Hexabromodibenzo-*p*-dioxin (HxBDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,7,8,9-Hexabromodibenzo-*p*-dioxin (HxBDD) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,6,7,8,9-Octabromodibenzo-*p*-dioxin (OBDD) | serum | | Pool | Pool | | Pool |
| 2,3,7,8,-Tetrabromodibenzofuran (TBDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,7,8-Pentabromodibenzofuran (PeBDF) | serum | | Pool | Pool | | Pool |
| 2,3,4,7,8-Pentabromodibenzofuran (PeBDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,7,8-Hexabromodibenzofuran (HxBDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,6,7,8-Heptabromodibenzofuran (HpBDF) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,6,7,8,9-Octabromodibenzofuran (OBDF) | serum | | Pool | Pool | | Pool |
| **Dioxin-like Polychlorinated Biphenyls - cPCBs** |  | |  |  | |  |
| 3,3',4,4'-Tetrachlorobiphenyl (PCB 77) | serum | | Pool | Pool | | Pool |
| 3,4,4',5-Tetrachlorobiphenyl (PCB 81) | serum | | Pool | Pool | | Pool |
| 3,3',4,4',5-Pentachlorobiphenyl (PCB 126) | serum | | Pool | Pool | | Pool |
| 3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169) | serum | | Pool | Pool | | Pool |
| **Dioxin-like Polychlorinated Biphenyls - mPCBs** |  | |  |  | |  |
| 2,3,3',4,4'-Pentachlorobiphenyl (PCB 105) | serum | | Pool | Pool | | Pool |
| 2,3,3',4,4'-Pentachlorobiphenyl (PCB 114) | serum | | Pool | Pool | | Pool |
| 2,3',4,4',5-Pentachlorobiphenyl (PCB 118) | serum | | Pool | Pool | | Pool |
| 2',3,4,4',5-Pentachlorobiphenyl (PCB 123) | serum | | Pool | Pool | | Pool |
| 2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156) | serum | | Pool | Pool | | Pool |
| 2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157) | serum | | Pool | Pool | | Pool |
| 2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167) | serum | | Pool | Pool | | Pool |
| 2,3,3’,4,4’,5,5’-Heptachlorobiphenyl (PCB 189) | serum | | Pool | Pool | | Pool |
| **Non-dioxin-like Polychlorinated Biphenyls** |  | |  |  | |  |
| 2,4,4'-Trichlorobiphenyl (PCB 28) | serum | | Pool | Pool | | Pool |
| 2,2'3,5'-Tetrachloro biphenyl (PCB 44) | serum | | Pool | Pool | | Pool |
| 2,2',4,5'-Tetrachloro biphenyl (PCB 49) | serum | | Pool | Pool | | Pool |
| 2,2',5,5'-Tetrachlorobiphenyl (PCB 52) | serum | | Pool | Pool | | Pool |
| 2,3',4,4'-Tetrachlorobiphenyl (PCB 66) | serum | | Pool | Pool | | Pool |
| 2,4,4',5-Tetrachlorobiphenyl (PCB 74) | serum | | Pool | Pool | | Pool |
| 2,2’,3,4,5’-Pentachlorobiphenyl (PCB 87) | serum | | Pool | Pool | | Pool |
| 2,2',4,4',5-Pentachlorobiphenyl (PCB 99) | serum | | Pool | Pool | | Pool |
| 2,2',4,5,5'-Pentachlorobiphenyl (PCB 101) | serum | | Pool | Pool | | Pool |
| 2,3,3’,4’,6-Pentachlorobiphenyl (PCB 110) | serum | | Pool | Pool | | Pool |
| 2,2',3,3',4,4'-Hexachlorobiphenyl (PCB 128) | serum | | Pool | Pool | | Pool |
| 2,2',3,4,4',5' and 2,3,3’,4,4’,6-Hexachlorobiphenyl (PCB 138 & 158) | serum | | Pool | Pool | | Pool |
| 2,2',3,4',5,5'-Hexachlorobiphenyl (PCB 146) | serum | | Pool | Pool | | Pool |
| 2,2’,3,4’,5’,6-Hexachlorobiphenyl (PCB 149) | serum | | Pool | Pool | | Pool |
| 2,2’,3,5,5’,6-Hexachlorobiphenyl (PCB 151) | serum | | Pool | Pool | | Pool |
| 2,2',4,4',5,5'-Hexachlorobiphenyl (PCB 153) | serum | | Pool | Pool | | Pool |
| 2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB 170) | serum | | Pool | Pool | | Pool |
| 2,2',3,3',4,5,5'-Heptachlorobiphenyl (PCB 172) | serum | | Pool | Pool | | Pool |
| 2,2',3,3',4,5',6'-Heptachlorobiphenyl (PCB 177) | serum | | Pool | Pool | | Pool |
| 2,2',3,3',5,5',6-Heptachlorobiphenyl (PCB 178) | serum | | Pool | Pool | | Pool |
| 2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180) | serum | | Pool | Pool | | Pool |
| 2,2',3,4,4',5',6-Heptachlorobiphenyl (PCB 183) | serum | | Pool | Pool | | Pool |
| 2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB 187) | serum | | Pool | Pool | | Pool |
| 2,2’,3,3’,4,4’,5,5’-Octachlorobiphenyl (PCB 194) | serum | | Pool | Pool | | Pool |
| 2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl (PCB 195) | serum | | Pool | Pool | | Pool |
| 2,2’,3,3’,4,4’,5,6’ and 2,2’,3,4,4’,5,5’,6-Octachlorobiphenyl (PCB 196 & 203) | serum | | Pool | Pool | | Pool |
| 2,2’,3,3’,4,5,5’,6-Octachlorobiphenyl (PCB 199) (previosuly PCB 201) | serum | | Pool | Pool | | Pool |
| 2,2’,3,3’,4,4’,5,5’,6-Nonachlorobiphenyl (PCB 206) | serum | | Pool | Pool | | Pool |
| 2,2',3,3',4,4',5,5',6,6'-Decachloro biphenyl (PCB 209) | serum | | Pool | Pool | | Pool |
| **Hydroxylated Polychlorinated Biphenyls** |  | |  |  | |  |
| 2,3,3',4',5-pentachloro-4-biphenylol (4-HO-CB107) (PCB 105+118) | serum | | Pool | Pool | | Pool |
| 2,2',3,4',5,5'-hexachloro-4-biphenylol (4-HO-CB146) (PCB 138+153) | serum | | Pool | Pool | | Pool |
| 2,2',3,4',5,5,6'-heptachloro-4-biphenylol (4-HO-CB187) (PCB 187) | serum | | Pool | Pool | | Pool |
| **Polybrominated Diphenyl Ethers** |  | |  |  | |  |
| 2,2',4’-Tribromodiphenyl ether (BDE 17) | serum | | Pool | ● | | ● |
| 2,4,4’-Tribromodiphenyl ether (BDE 28) | serum | | Pool | ● | | ● |
| 2,2’,4,4’-Tetrabromodiphenyl ether (BDE 47) | serum | | Pool | ● | | ● |
| 2,3',4,4'-Tetrabromodiphenyl ether (BDE 66) | serum | | Pool | ● | | ● |
| 2,2’,3,4,4’-Pentabromodiphenyl ether (BDE 85) | serum | | Pool | ● | | ● |
| 2,2’,4,4’,5-Pentabromodiphenyl ether (BDE 99) | serum | | Pool | ● | | ● |
| 2,2’,4,4’,6-Pentabromodiphenyl ether (BDE 100) | serum | | Pool | ● | | ● |
| 2,2’,4,4’,5,5’-Hexabromobiphenyl (BB 153) | serum | | Pool | ● | | ● |
| 2,2’,4,4’,5,6’-Hexabromodiphenyl ether (BDE 154) | serum | | Pool | ● | | ● |
| 2,2’,4,4’,5,5’-Hexabromodiphenyl ether (BDE 153) | serum | | Pool | ● | | ● |
| 2,2’,3,4,4’,5’,6-Heptabromodiphenyl ether (BDE 183) | serum | | Pool | ● | | ● |
| 2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether (BDE 209) | serum | | Pool | ● | | ● |
| **Polychlorinated Naphthalenes** |  | |  |  | |  |
| 1,2,3,4-Tetrachlorinated naphthalene (PCN 27) | serum | | Pool | Pool | | Pool |
| 1,2,3,5,7- and 1,2,4,6,7-Pentachlorinated naphthalene (PNC 52 & 60) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,5,7- and 1,2,3,5,6,8-Hexachlorinated naphthalene (PNC 64 & 68) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,6,7- and 1,2,3,5,6,7-Hexachlorinated naphthalene (PNC 66 & 67) | serum | | Pool | Pool | | Pool |
| 1,2,3,5,7,8-Hexachlorinated naphthalene (PCN 69) | serum | | Pool | Pool | | Pool |
| 1,2,3,4,5,6,7-Heptachlorinated naphthalene (PCN 73) | serum | | Pool | Pool | | Pool |
| **Volatile Organic Compounds (VOCs)** |  | |  |  | |  |
| 1,1,1-Trichloroethane4 | whole blood | | ● | ● | | ● |
| 1,1,2,2-Tetrachloroethane4 | whole blood | | ● | ● | |  |
| 1,1,2-Trichloroethane4 | whole blood | | ● | ● | |  |
| 1,1-Dichloroethane4 | whole blood | | ● | ● | |  |
| 1,1-Dichloroethene4 | whole blood | | ● | ● | |  |
| 1,2-dibromo-3-chloropropane4 | whole blood | | ● | ● | |  |
| 1,2-Dichlorobenzene4 | whole blood | | ● | ● | | ● |
| 1,2-Dichloroethane4 | whole blood | | ● | ● | | ● |
| 1,2-Dichloropropane4 | whole blood | | ● | ● | |  |
| 1,3-Dichlorobenzene4 | whole blood | | ● | ● | | ● |
| 1,4-Dichlorobenzene4 | whole blood | | ● | ● | | ● |
| 2,5-Dimethylfuran4 | whole blood | | ● | ● | | ● |
| Acrylonitrile4 | whole blood | | ● | ● | | ● |
| Benzene4 | whole blood | | ● | ● | | ● |
| Bromodichloromethane4 | whole blood | | ● | ● | | ● |
| Bromoform4 | whole blood | | ● | ● | | ● |
| Carbon Tetrachloride4 | whole blood | | ● | ● | | ● |
| Chlorobenzene4 | whole blood | | ● | ● | | ● |
| Chloroform4 | whole blood | | ● | ● | | ● |
| Chloroform4 | water | | ● | ● | | ● |
| *cis*-1,2-Dichloroethene4 | whole blood | | ● | ● | |  |
| Dibromochloromethane4 | whole blood | | ● | ● | | ● |
| Dibromomethane4 | whole blood | | ● | ● | |  |
| Ethylbenzene4 | whole blood | | ● | ● | | ● |
| Furan4 | whole blood | | ● | ● | | ● |
| Hexachloroethane4 | whole blood | | ● | ● | |  |
| m-/p-Xylene4 | whole blood | | ● | ● | | ● |
| Methylene Chloride4 | whole blood | | ● | ● | | ● |
| Methyl-tert-Butyl Ether (MTBE) 4 | whole blood | | ● | ● | | ● |
| Nitrobenzene4 | whole blood | | ● | ● | | ● |
| *o*-Xylene4 | whole blood | | ● | ● | | ● |
| Styrene4 | whole blood | | ● | ● | | ● |
| Tetrachloroethene4 | whole blood | | ● | ● | | ● |
| Toluene4 | whole blood | | ● | ● | | ● |
| *trans*-1,2-Dichloroethene4 | whole blood | | ● | ● | |  |
| Trichloroethene4 | whole blood | | ● | ● | | ● |
| 1,4-Dioxane4 | whole blood | | ● | ● | | ● |
| 1,2-Dibromoethane4 | whole blood | | ● | ● | | ● |
| n-Hexane4 | whole blood | | ● | ● | | ● |
| Nitromethane4 | whole blood | | ● | ● | | ● |
| 1,1,1,2-Tetrachloroethane4 | whole blood | | ● | ● | | ● |
| Cumene/isopropylbenzene4 | whole blood | | ● | ● | | ● |
| 1,2,3-Trichloropropane4 | whole blood | | ● | ● | | ● |
| Ethyl acetate4 | whole blood | |  |  | | ● |
| 1-Bromopropane/Propyl bromide4 | whole blood | |  |  | | ● |
| Methylcyclopentane4 | whole blood | |  |  | | ● |
| Cyclohexane4 | whole blood | |  |  | | ● |
| Benzonitrile4 | whole blood | |  |  | | ● |
| AAA-Trifluorotoluene/α,α,α-Trifluorotoluene4 | whole blood | |  |  | | ● |
| Chloroethane4 | whole blood | |  |  | | ● |
| Methyl isobutyl ketone4 | whole blood | |  |  | | ● |
| Tetrahydrofuran4 | whole blood | |  |  | | ● |
| Vinyl bromide4 | whole blood | |  |  | | ● |
| Heptane4 | whole blood | |  |  | | ● |
| Octane4 | whole blood | |  |  | | ● |
| **Volatile Organic Compound Metabolites (VOC metabolites) (28)** |  | |  |  | |  |
| N-Acetyl-S-(2-carbamoylethyl)-L-cysteine | urine | |  | ● | | ● |
| N-Acetyl-S-(N-methylcarbamoyl)-L-cysteine | urine | |  | ● | | ● |
| 2-Aminothiazoline-4-carboxylic acid | urine | |  | ● | | ● |
| N-Acetyl-S-(benzyl)-L-cysteine | urine | |  | ● | | ● |
| N-Acetyl-S-(n-propyl)-L-cysteine | urine | |  | ● | | ● |
| N-Acetyl-S- (2-carboxyethyl)-L-Cysteine | urine | |  | ● | | ● |
| N-acetyl-S-(2-cyanoethyl)-L-cysteine | urine | |  | ● | | ● |
| N-acetyl-S-(1,2-dichlorovinyl)-L-cysteine | urine | |  | ● | | ● |
| N-acetyl-S-(2,2-dichlorovinyl)-L-cysteine | urine | |  | ● | | ● |
| N-Acetyl-S- (3,4-dihydroxybutyl)-L-Cysteine | urine | |  | ● | | ● |
| N-Acetyl-S-(dimethylphenyl)-L-Cysteine | urine | |  | ● | | ● |
| N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine | urine | |  | ● | | ● |
| N-Acetyl-S- (2-hydroxyethyl)-L-cysteine | urine | |  | ● | | ● |
| N-Acetyl-S- (3-hydroxypropyl)-L-Cysteine | urine | |  | ● | | ● |
| N-Acetyl-S- (2-hydroxypropyl)-L-Cysteine | urine | |  | ● | | ● |
| N-Acetyl-S-(3-hydroxypropyl-1-methyl)-L-cysteine | urine | |  | ● | | ● |
| Mandelic acid | urine | |  | ● | | ● |
| 2-Methylhippuric acid | urine | |  | ● | | ● |
| 3-Methylhippuric acid & 4-methylhippuric acid | urine | |  | ● | | ● |
| N-Acetyl-S- (1-hydroxyMethyl-2-Propenyl)-L-Cysteine | urine | |  | ● | | ● |
| N-Acetyl-S- (2-hydroxy-3-butenyl)-L-Cysteine | urine | |  | ● | | ● |
| N-Acetyl-S- (4-hydroxy-2-butenyl)-L-Cysteine | urine | |  | ● | | ● |
| t,t-Muconic acid | urine | |  | ● | | ● |
| N-Acetyl-S-(phenyl-2-hydroxyethyl)-L-cysteine | urine | |  | ● | | ● |
| Phenylglyoxylic acid | urine | |  | ● | | ● |
| N-Acetyl-S-(phenyl)-L-cysteine | urine | |  | ● | | ● |
| N-Acetyl-S-(trichlorovinyl)-L-cysteine | urine | |  | ● | | ● |
| N-Acetyl-S(2hydroxy3methyl3butenyl)-Lcys | urine | |  |  | | ● |
| N-Acetyl-S(2hydroxy2methyl3butenyl)-Lcys | urine | |  |  | | ● |
| 2-Thioxothiazolidine-4-carboxylic acid | urine | |  | ● | | ● |
| **Heterocyclic Amine (HCA) Hemoglobin Adducts** |  | |  |  | |  |
| *2-Amino-3-methylimidazo[4,5-f]quinoline (Hb-IQ)* | packed cells | |  |  | | ● |
| *2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (Hb-PhIP)* | packed cells | |  |  | | ● |
| *2-Amino-9H-pyrido[2,3-b]indole (Hb-A-α-C)* | packed cells | |  |  | | ● |
| *(2-Amino-3-methyl)-9H-pyrido[2,3-b]indole (Hb-MeA-α-C)* | packed cells | |  |  | | ● |
| *3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole (Hb-Trp-P-1)* | packed cells | |  |  | | ● |
| *1-Methyl-3-amino-5H-pyrido[4,3-b]indole (Hb-Trp-P-2)* | packed cells | |  |  | | ● |
| *2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole (Hb-Glu-P1)* | packed cells | |  |  | | ● |
| *2-Aminodipyrido[1,2-a:3',2'-d]imidazole (Hb-Glu-P-2)* | packed cells | |  |  | | ● |
| **Other** |  | |  |  | |  |
| Perchlorate | urine | | ● | ● | | ● |
| Thiocyanate | urine | | ● | ● | | ● |
| Nitrate | urine | | ● | ● | | ● |
| Ethylene Oxide | packed cells | |  |  | | ● |
| Acrylamide | packed cells | | ● |  | | ● |
| Formaldehyde | packed cells | |  |  | | ● |
| Glycidamide | packed cells | | ● |  | | ● |
| 0All participants ages 3 and older  1All participants ages 6 and older | |  | | |  | | |
| 2 Participants ages 1 -11 years and all participants 12+ years | | | | | | | |
| 3 Participants ages 6+ years, one-third sample | | | | |  | | |

4Participants-ages 12+ years, one-half sample