

Attachment 5a

***Laboratory Assessments
2017-18***

NHANES Laboratory Assessments Laboratory Analytes by Age Group

Test Name	Sample	Matrix
Ages 1-2		
Complete Blood Count	Full	Whole blood
Congenital Cytomegalovirus (CMV)	Full	Serum
C-reactive Protein (CRP)	Full	Serum
Erythrocyte Folate	Full	Whole blood
Ferritin	Full	Serum
Hepatitis B Surface Antibody (Anti-HBs) 2 years and older	Full	Serum
Serum Total and Folate Forms	Full	Serum
Transferrin Receptor	Full	Serum
Vitamin D	Full	Serum
Ages 3-5		
Complete Blood Count	Full	Whole blood
Congenital Cytomegalovirus (CMV)	Full	Serum
C-reactive Protein (CRP)	Full	Serum
Erythrocyte Folate	Full	Whole blood
Ferritin	Full	Serum
Hepatitis Profile**	Full	Serum
Serum Total and Folate Forms	Full	Serum
Transferrin Receptor	Full	Serum
Urine Flow Rate	Full	Urine
Vitamin D	Full	Serum
Ages 6-11		
Albumin/Creatinine	Full	Urine
Cholesterol (Total)/ High Density Lipoprotein Cholesterol (HDL)	Full	Serum
Complete Blood Count	Full	Whole blood
C-reactive Protein (CRP)	Full	Serum
Erythrocyte Folate	Full	Whole blood
Hepatitis Profile**	Full	Serum
Serum Total and Folate Forms	Full	Serum
Urine flow rate	Full	Urine
Vitamin D	Full	Serum
Ages 12-19		
Albumin/Creatinine	Full	Urine
Biochemistry Profile*	Full	Serum
Chlamydia trachomatis (14-19 years)	Full	Urine
Cholesterol (Total)/ High Density Lipoprotein Cholesterol (HDL)	Full	Serum
Complete Blood Count	Full	Whole blood
C-reactive Protein (CRP)	Full	Serum
Erythrocyte Folate	Full	Whole blood
Ferritin	Full	Serum
Glucose, fasting	One-half	Plasma Na2F
Glycohemoglobin	Full	Whole blood
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

Test Name	Sample	Matrix
Insulin	One-half	Serum
Serum Iron (Frozen)	Full	Serum
Serum Total and Folate Forms	Full	Serum
Transferrin Receptor (females)	Full	Serum
Triglycerides/Low Density Lipoprotein Cholesterol	One-half	Serum
Trichomonas vaginalis (14-19 years)	Full	Urine
Unsaturated Iron-Binding Capacity (UIBC)	Full	Serum
Urine flow rate	Full	Serum
Vitamin D	Full	Serum
Ages 20 and older		
Albumin/Creatinine	Full	Urine
Biochemistry Profile*	Full	Serum
Chlamydia trachomatis (20-39 years)	Full	Urine
Cholesterol (Total)/ High Density Lipoprotein Cholesterol (HDL)	Full	Serum
Complete Blood Count	Full	Whole blood
C-reactive Protein (CRP)	Full	Serum
Erythrocyte Folate	Full	Whole blood
Ferritin	Full	Serum
Glucose, fasting	One-half	Plasma Na2F
Glycohemoglobin	Full	Whole blood
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
Insulin	One-half	Serum
Serum Iron (Frozen)	Full	Serum
Serum Total and Folate Forms	Full	Serum
Transferrin Receptor (females 20-49 yrs)	Full	Serum
Triglycerides/Low Density Lipoprotein Cholesterol	One-half	Serum
Trichomonas vaginalis (20-59 years)	Full	Urine
Unsaturated Iron-Binding Capacity (UIBC)	Full	Serum
Urine flow rate	Full	Urine
Vitamin D	Full	Serum
*Biochemistry Profile		
Albumin		
Alkaline phosphatase		
Aspartate aminotransferase (AST)		
Alanine aminotransferase (ALT)		
Blood urea nitrogen (BUN)		
Bicarbonate (HCO ₃)		
Total calcium		
Total cholesterol		
Chloride		
CPK		
Creatinine		
Globulin		
Glucose		
v-glutamyltransferase (GGT)		
Iron		

Test Name	Sample	Matrix
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)		
Hepatitis D antibody (anti-HDV)		
Hepatitis E antibody (anti-HEV)		

Attachment 5 – NHANES Laboratory Assessments Attachment 5b - Laboratory Analytes by Survey Year

This list of chemicals represents those chemicals currently or planned as biomonitoring measurements by CDC. A blank cell indicates that the analyte will not be measured or reported in that NHANES cycle. WD=results were withdrawn d=cycled out (not measured)

Chemical / Metabolite Name	Matrix	05-06	07-08	09-10	11-12	13-14	15-16	17-18	Branch	Lab Contact
Adducts of Hemoglobin										
Acrylamide	packed rbc	•	d	d	no prbc	•	•	•	CCB	Vesper
Glycidamide	packed rbc	•	d	d	no prbc	•	•	•	CCB	Vesper
Ethylene Oxide	packed rbc					•	•	•	CCB	Vesper
Formaldehyde	packed rbc					•	•	•	CCB	Vesper
Personal Care and Consumer Product Chemicals and Metabolites										
Butyl paraben	urine	•	•	•	•	•	•	•	OAT	Ye
Ethyl paraben	urine	•	•	•	•	•	•	•	OAT	Ye
Methyl paraben	urine	•	•	•	•	•	•	•	OAT	Ye
Propyl paraben	urine	•	•	•	•	•	•	•	OAT	Ye
Triclocarban	urine					•	•	•	OAT	Ye
Triclosan	urine	•	•	•	•	•	•	•	OAT	Ye
Bisphenol A	urine	•	•	•	•	•	•	•	OAT	Ye
Bisphenol F	urine					•	•	•	OAT	Ye
Bisphenol S	urine					•	•	•	OAT	Ye
Benzophenone-3	urine	•	•	•	•	•	•	•	OAT	Ye
4-tert-Octyl phenol	urine	•	•	•	d				OAT	Ye
2,4-Dichlorophenol	urine	•	•	•	•	•	•	•	OAT	Ye
2,5-Dichlorophenol	urine	•	•	•	•	•	•	•	OAT	Ye
Disinfection By-Products										
Bromodichloromethane	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Bromodichloromethane	water	•	•	•	d				TVB	Chambers
Dibromochloromethane (Chlorodibromomethane)	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Dibromochloromethane (Chlorodibromomethane)	water	•	•	•	d				TVB	Chambers
Tribromomethane (Bromoform)	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Tribromomethane (Bromoform)	water	•	•	•	d				TVB	Chambers
Trichloromethane (Chloroform)	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Trichloromethane (Chloroform)	water	•	•	•	d				TVB	Chambers
Flame Retardant Metabolites										
Bis(1-chloro-2-propyl) phosphate (BCPP)	urine					• surplus		•	OAT	Calafat
Bis(2-chloroethyl) phosphate (BCEtP)	urine					• surplus		•	OAT	Calafat
Bis(1,3-dichloro-2-propyl) phosphate (BDCPP)	urine					• surplus		•	OAT	Calafat

Dibenzyl phosphate (DBzP)	urine					• surplu s		•	OAT	Calafat
Dibutyl phosphate (DBuP)	urine					• surplu s		•	OAT	Calafat
Di-p-cresylphosphate (DpCP)	urine					• surplu s		•	OAT	Calafat
Di-o-cresylphosphate (DoCP)	urine					• surplu s		•	OAT	Calafat
Diphenyl phosphate (DPhP)	urine					• surplu s		•	OAT	Calafat
2,3,4,5-Tetrabromobenzoic acid (TBBA)	urine					• surplu s		•	OAT	Calafat
Fungicides and Metabolites										
Ethylenethiourea (ETU)	urine	•	•	d					OAT	Calafat
<i>ortho</i> -Phenylphenol	urine	•	•	•	d				OAT	Calafat
Pentachlorophenol	urine	d							OAT	Calafat
Propylenethiourea (PTU)	urine	•	•	d					OAT	Calafat
Herbicides and Metabolites										
Atrazine	urine	Not measure d	•	d					OAT	Calafat
Atrazine mercapturate	urine	Not measure d	•	d					OAT	Calafat
Desethyl atrazine	urine	Not measure d	•	d					OAT	Calafat
Desethyl atrazine mercapturate	urine	Not measure d	•	d					OAT	Calafat
Desisopropyl atrazine	urine	Not measure d	•	d					OAT	Calafat
Desisopropyl atrazine mercapturate	urine	Not measure d	•	d					OAT	Calafat
Diaminochlorotriazine	urine	Not measure d	•	d					OAT	Calafat
2,4-Dichlorophenoxyacetic acid	urine	Not measure d	•	•	•	•	•	•	OAT	Ospina
2,4,5-Trichlorophenoxyacetic acid	urine	Not measure d	•	•	d	•	•	•	OAT	Ospina
Herbicides: Substituted Ureas										
Bensulfuron-methyl	urine	•	•	d					OAT	Calafat
Chlorsulfuron	urine	•	•	d					OAT	Calafat
Ethametsulfuron-methyl	urine	•	•	d					OAT	Calafat
Foramsulfuron	urine	•	•	d					OAT	Calafat
Halosulfuron	urine	•	•	d					OAT	Calafat
Mesosulfuron-methyl	urine	•	•	d					OAT	Calafat
Metsulfuron-methyl	urine	•	•	d					OAT	Calafat
Nicosulfuron	urine	•	•	d					OAT	Calafat
Oxasulfuron	urine	•	•	d					OAT	Calafat
Primisulfuron-methyl	urine	•	•	d					OAT	Calafat
Prosulfuron	urine	•	•	d					OAT	Calafat
Rimsulfuron	urine	•	•	d					OAT	Calafat

Sulfometuron-methyl	urine	•	•	d					OAT	Calafat
Sulfosulfuron	urine	•	•	d					OAT	Calafat
Thifensulfuron-methyl	urine	•	•	d					OAT	Calafat
Triasulfuron	urine	•	•	d					OAT	Calafat
Triflusulfuron-methyl	urine	•	•	d					OAT	Calafat
Insect Repellent										
N,N-Diethyl- <i>meta</i> -toluamide (DEET)	urine	Not measured	•	•	•	•	•	•	OAT	Ospina
3-(Diethylcarbamoyl)benzoic acid (DEET acid)	urine	Not measured	•	•	•	•	•	•	OAT	Ospina
N,N-Diethyl-3-(hydroxymethyl)benzamide (Desethyl hydroxy DEET)	urine	Not measured	•	•	•	•	•	•	OAT	Ospina
3-(Ethylcarbamoyl)benzoic acid	urine							•	OAT	Ospina
Insecticides and Pesticides										
Organochlorine Pesticides and Metabolites										
Aldrin	serum	d							OAT	Sjodin
Dieldrin	serum	d							OAT	Sjodin
Oxychlorane	serum	P	P	P	P	P	P	P	OAT	Sjodin
Heptachlor Epoxide	serum	d							OAT	Sjodin
<i>trans</i> -Nonachlor	serum	P	P	P	P	P	P	P	OAT	Sjodin
<i>p,p'</i> -DDT	serum	P	P	P	P	P	P	P	OAT	Sjodin
<i>p,p'</i> -DDE	serum	P	P	P	P	P	P	P	OAT	Sjodin
<i>o,p'</i> -DDT	serum	d							OAT	Sjodin
Endrin	serum	d							OAT	Sjodin
Hexachlorobenzene	serum	P	P	P	P	P	P	P	OAT	Sjodin
<i>beta</i> -Hexachlorocyclohexane	serum	P	P	P	P	P	P	P	OAT	Sjodin
<i>gamma</i> -Hexachlorocyclohexane	serum	P	P	P	P	P	P	P	OAT	Sjodin
Mirex	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,4,5-Trichlorophenol	urine	•	•	•	d				OAT	Ye
2,4,6-Trichlorophenol	urine	•	•	•	d				OAT	Ye
Organophosphorus Insecticides: Dialkyl Phosphate Metabolites										
Dimethylphosphate	urine	•	•	•	•	•	•	•	OAT	Ospina
Dimethylthiophosphate	urine	•	•	•	•	•	•	•	OAT	Ospina
Dimethyldithiophosphate	urine	•	•	•	•	•	•	•	OAT	Ospina
Diethylphosphate	urine	•	•	•	•	•	•	•	OAT	Ospina
Diethylthiophosphate	urine	•	•	•	•	•	•	•	OAT	Ospina
Diethyldithiophosphate	urine	•	•	•	•	•	•	•	OAT	Ospina
Organophosphorus Insecticides: Specific Pesticides and Metabolites										
Malathion dicarboxylic acid	urine	not measured	•	•	•	•	•	•	OAT	Ospina
3,5,6-Trichloro-2-pyridinol (TCPy)	urine	not measured	•	•	•	•	•	•	OAT	Ospina
2-diethylamino-6-methyl pyrimidin-4-ol	urine	not measured	d	-	-	-	-	-	OAT	Ospina
2-Isopropyl-4-methyl-6-hydroxypyrimidine	urine	not measured	•	•	•	•	•	•	OAT	Ospina

<i>para</i> -Nitrophenol	urine	not measured	•	•	•	•	•	•	OAT	Ospina
Dimethoate	urine	•	•	d					OAT	Calafat
Omethoate	urine	•	•	d					OAT	Calafat
Acephate	urine	•	•	d					OAT	Calafat
Methamidaphos	urine	•	•	d					OAT	Calafat
Pyrethroid Pesticides										
<i>cis</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (cis-DCCA)	urine	not measured	method in dev	d					OAT	Ospina
<i>trans</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (trans-DCCA)	urine	not measured	•	•	•	•	•	•	OAT	Ospina
3-Phenoxybenzoic acid (3PBA)	urine	not measured	•	•	•	•	•	•	OAT	Ospina
4-Fluoro-3-phenoxybenzoic acid (4F3PBA)	urine	not measured	•	•	•	•	•	•	OAT	Ospina
<i>cis</i> -3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid (cis-DBCA)	urine	not measured	•	•	•	•	•	•	OAT	Ospina
Other Pesticide Metabolites										
Carbofuranphenol	urine	d							OAT	Calafat
2-Isopropoxyphenol	urine	d							OAT	Calafat
Metals and Metalloids										
Antimony	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Arsenic (total)	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Arsenic (V) acid	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Arsenobetaine	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Arsenocholine	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Arsenous (III) acid	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Dimethylarsinic acid	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Monomethylarsonic acid	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Trimethylarsine oxide	urine	•	•	•	•	d			IRAT	Caldwell
Barium	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Beryllium	urine	•	•	•	d				IRAT	Caldwell
Cadmium	whole blood	•	•	•	•	•	•	•	IRAT	Caldwell
Cadmium	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Cesium	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Chromium	urine							•	IRAT	Caldwell
Chromium	whole blood							•	IRAT	Caldwell
Cobalt	whole blood							•	IRAT	Caldwell
Cobalt	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Copper	serum				•	•	•	•	IRAT	Caldwell
Lead	whole blood	•	•	•	•	•	•	•	IRAT	Caldwell
Lead	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Manganese	whole blood				•	•	•	•	IRAT	Caldwell
Manganese	urine				•	•	•	•	IRAT	Caldwell
Mercury (total)	whole blood	•	•	•	•	•	•	•	IRAT	Caldwell

Mercury (inorganic)	whole blood	•	•	•	•	•	•	•	IRAT	Caldwell
Mercury (ethyl)	whole blood				•	•	•	•	IRAT	Caldwell
Mercury (methyl)	whole blood				•	•	•	•	IRAT	Caldwell
Mercury	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Molybdenum	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Nickel	urine							•	IRAT	Caldwell
Platinum	urine	•	•	•	d				IRAT	Caldwell
Selenium	whole blood				•	•	•	•	IRAT	Caldwell
Selenium	serum				•	•	•	•	IRAT	Caldwell
Strontium	urine				•	•	•	•	IRAT	Caldwell
Thallium	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Tin	urine				•	•	•	•	IRAT	Caldwell
Tungsten	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Uranium	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Zinc	serum				•	•	•	•	IRAT	Caldwell
Iodine	urine	•	•	•	•	•	•	•	IRAT	Caldwell
Perchlorate and Other Anions										
Perchlorate	urine	•	•	•	•	•	•	•	TVB	Morel
Perchlorate	water	•	•	d					TVB	Morel
Thiocyanate	urine	•	•	•	•	•	•	•	TVB	Morel
Nitrate	urine	•	•	•	•	•	•	•	TVB	Morel
Nitrate	water	•	•	d					TVB	Morel
Iodide	water	•	•	d					TVB	Morel
Perfluoroalkyl and Polyfluoroalkyl Substances: Surfactants										
Perfluorobutane sulfonic acid (PFBS)	serum	•	•	•	•	•	d		OAT	Ye
Perfluorodecanoic acid (PFDeA)	serum	•	•	•	•	•	•	•	OAT	Ye
Perfluorododecanoic acid (PFDoA)	serum	•	•	•	•	•	•	•	OAT	Ye
Perfluoroheptanoic acid (PFHpA)	serum	•	•	•	•	•	d		OAT	Ye
Perfluorohexane sulfonic acid (PFHxS)	serum	•	•	•	•	•	•	•	OAT	Ye
Perfluorononanoic acid (PFNA)	serum	•	•	•	•	•	•	•	OAT	Ye
Perfluorooctanoic acid (PFOA)	serum	•	•	•	•	d			OAT	Ye
Perfluorooctane sulfonic acid (PFOS)	serum	•	•	•	•	d			OAT	Ye
Perfluorooctane sulfonamide (PFOSA)	serum	•	•	•	•	d			OAT	Ye
2-(N-Ethyl- Perfluorooctane sulfonamido) acetic acid (Et-PFOSA-AcOH)	serum	•	•	•	•	d			OAT	Ye
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid (Me-PFOSA-AcOH)	serum	•	•	•	•	•	•	•	OAT	Ye
Perfluoroundecanoic acid (PFUA)	serum	•	•	•	•	•	•	•	OAT	Ye
n-Perfluorooctanoic acid (n-PFOA)	serum					• surplu s		•	OAT	Ye
Branched Perfluorooctanoic acid isomers (Sb-PFOA)*	serum					• surplu s		•	OAT	Ye
n-Perfluorooctane sulfonic (n-PFOS)	serum					• surplu s		•	OAT	Ye
Perfluoromethylheptane sulfonic acid isomers (Sm-PFOS)*	serum					• surplu s		•	OAT	Ye

Perfluorodimethylhexane sulfonic acid isomers (Sm2-PFOS)*	serum					• surpl s	•	•	OAT	Ye
Phthalate Metabolites and Phthalate Alternatives										
Mono-benzyl phthalate (MBzP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-2-hydroxybutyl phthalate (MHBP)	urine					• surpl s	•	•	OAT	Ye
Mono-n-butyl phthalate (MnBP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-iso-butyl phthalate (MiBP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-2-hydroxyisobutyl phthalate (MHIBP)	urine					• surpl s	•	•	OAT	Ye
Mono-cyclohexyl phthalate (MCHP)	urine	•	•	•	d				OAT	Ye
Mono-ethyl phthalate (MEP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-2-ethylhexyl phthalate (MEHP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHPP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-(2-ethyl-5-carboxypentyl) phthalate (MECPP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-carboxyisononyl phthalate (MCNP)	urine		•	•	•	•	•	•	OAT	Ye
Mono-hydroxyisodecyl phthalate (MHDP)	urine							•	OAT	Ye
Mono-oxoisodecyl phthalate (MODP)	urine							•	OAT	Ye
Mono-isononyl phthalate (MiNP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-oxoisononyl phthalate (MONP)	urine							•	OAT	Ye
Mono-carboxyisoctyl phthalate (MCOP)	urine		•	•	•	•	•	•	OAT	Ye
Mono-methyl phthalate (MMP)	urine	•	•	•	•	d			OAT	Ye
Mono-(3-carboxypropyl) phthalate (MCP)	urine	•	•	•	•	•	•	•	OAT	Ye
Mono-n-octyl phthalate (MOP)	urine	•	•	•	d				OAT	Ye
Cyclohexane 1,2-dicarboxylic acid mono hydroxy isononyl ester (MHNCH*)	urine				•	•	•	•	OAT	Ye
Cyclohexane-1,2-dicarboxylic acid-mono(carboxyoctyl) ester (MCOCH)	urine					•	•	•	OAT	Ye
Phytoestrogens										
Daidzein	urine	•	•	•	d				NBB	Ryback
Enterodiol	urine	•	•	•	d				NBB	Ryback
Enterolactone	urine	•	•	•	d				NBB	Ryback
Equol	urine	•	•	•	d				NBB	Ryback
Genistein	urine	•	•	•	d				NBB	Ryback
O-Desmethylangolensin	urine	•	•	•	d				NBB	Ryback
Polybrominated Diphenyl Ethers and Brominated Biphenyl 153										
2,2',4'-Tribromodiphenyl ether (BDE 17)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,4,4'-Tribromodiphenyl ether (BDE 28)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,2',4,4'-Tetrabromodiphenyl ether (BDE 47)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,3',4,4'-Tetrabromodiphenyl ether (BDE 66)	serum	P	P	P	•	•	•	•	OAT	Sjodin

2,2',3,4,4'-Pentabromodiphenyl ether (BDE 85)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,2',4,4',5-Pentabromodiphenyl ether (BDE 99)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,2',4,4',6-Pentabromodiphenyl ether (BDE 100)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,2',4,4',5,5'-Hexabromodiphenyl ether (BDE 153)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,2',4,4',5,6'-Hexabromodiphenyl ether (BDE 154)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,2',3,4,4',5',6-Heptabromodiphenyl ether (BDE 183)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether (BDE 209)	serum	P	P	P	•	•	•	•	OAT	Sjodin
2,2',4,4',5,5'-Hexabromobiphenyl (BB 153)	serum	P	P	P	•	•	•	•	OAT	Sjodin
Polychlorinated Dibenzo-<i>p</i>-dioxins										
1,2,3,4,6,7,8-Heptachlorodibenzo- <i>p</i> -dioxin (HpCDD)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,4,7,8-Hexachlorodibenzo- <i>p</i> -dioxin (HxCDD)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,6,7,8-Hexachlorodibenzo- <i>p</i> -dioxin (HxCDD)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,7,8,9-Hexachlorodibenzo- <i>p</i> -dioxin (HxCDD)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,4,6,7,8,9-Octachlorodibenzo- <i>p</i> -dioxin (OCDD)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,7,8-Pentachlorodibenzo- <i>p</i> -dioxin (PeCDD)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,3,7,8-Tetrachlorodibenzo- <i>p</i> -dioxin (TCDD)	serum	P	P	P	P	P	P	P	OAT	Sjodin
Polychlorinated Dibenzofurans										
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	serum	P	P	P	P	P	P	P	OAT	Sjodin
Dioxin-like Polychlorinated Biphenyls: Coplanar PCBs										
3,3',4,4'-Tetrachlorobiphenyl (PCB 77)	serum	P	P	P	P	P	P	P	OAT	Sjodin
3,4,4',5-Tetrachlorobiphenyl (PCB 81)	serum	P	P	P	P	P	P	P	OAT	Sjodin

3,3',4,4',5-Pentachlorobiphenyl (PCB 126)	serum	P	P	P	P	P	P	P	OAT	Sjodin
3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)	serum	P	P	P	P	P	P	P	OAT	Sjodin
Dioxin-like Polychlorinated Biphenyls: Mono-ortho-Substituted PCBs										
2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,3,3',4,4'-Pentachlorobiphenyl (PCB 114)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2',3,4,4',5-Pentachlorobiphenyl (PCB 123)	serum	P	P	d					OAT	Sjodin
2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)	serum	P	P	P	P	P	P	P	OAT	Sjodin
Polychlorinated Biphenyls: Non-Dioxin-Like										
2,4,4'-Trichlorobiphenyl (PCB 28)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,5'-Tetrachloro biphenyl (PCB 44)	serum	P	P	d					OAT	Sjodin
2,2',4,5'-Tetrachloro biphenyl (PCB 49)	serum	P	P	d					OAT	Sjodin
2,2',5,5'-Tetrachlorobiphenyl (PCB 52)	serum	P	P	d					OAT	Sjodin
2,3',4,4'-Tetrachlorobiphenyl (PCB 66)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,4,4',5-Tetrachlorobiphenyl (PCB 74)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,4,5'-Pentachlorobiphenyl (PCB 87)	serum	P	P	d					OAT	Sjodin
2,2',4,4',5-Pentachlorobiphenyl (PCB 99)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',4,5,5'-Pentachlorobiphenyl (PCB 101)	serum	P	P	d					OAT	Sjodin
2,3,3',4',6-Pentachlorobiphenyl (PCB 110)	serum	P	P	d					OAT	Sjodin
2,2',3,3',4,4'-Hexachlorobiphenyl (PCB 128)	serum	P	P	d					OAT	Sjodin
2,2',3,4,4',5' and 2,3,3',4,4',6-Hexachlorobiphenyl (PCB 138 & 158)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,4',5,5'-Hexachlorobiphenyl (PCB 146)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,4',5',6-Hexachlorobiphenyl (PCB 149)	serum	P	P	d					OAT	Sjodin
2,2',3,5,5',6-Hexachlorobiphenyl (PCB 151)	serum	P	P	d					OAT	Sjodin
2,2',4,4',5,5'-Hexachlorobiphenyl (PCB 153)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB 170)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,3',4,5,5'-Heptachlorobiphenyl (PCB 172)	serum	P	P	d					OAT	Sjodin

2,2',3,3',4,5',6'-Heptachlorobiphenyl (PCB 177)	serum	P	P	d					OAT	Sjodin
2,2',3,3',5,5',6'-Heptachlorobiphenyl (PCB 178)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,4,4',5,6'-Heptachlorobiphenyl (PCB 183)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,4',5,5',6'-Heptachlorobiphenyl (PCB 187)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (PCB 194)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,3',4,4',5,6'-Octachlorobiphenyl (PCB 195)	serum	P	P	d					OAT	Sjodin
2,2',3,3',4,4',5,6' and 2,2',3,4,4',5,5',6'-Octachlorobiphenyl (PCB 196 & 203)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,3',4,5,5',6'-Octachlorobiphenyl (PCB 199)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,3',4,4',5,5',6'-Nonachlorobiphenyl (PCB 206)	serum	P	P	P	P	P	P	P	OAT	Sjodin
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (PCB 209)	serum	P	P	P	P	P	P	P	OAT	Sjodin
Polycyclic Aromatic Hydrocarbons										
2-Hydroxyfluorene	urine	•	•	•	•	•	•	•	OAT	Calafat
3-Hydroxyfluorene	urine	•	•	•	•	•	•	•	OAT	Calafat
9-Hydroxyfluorene	urine	•	•	•	•	•	•	•	OAT	Calafat
1-Hydroxyphenanthrene	urine	•	•	•	•	•	•	•	OAT	Calafat
2-Hydroxyphenanthrene	urine	•	•	•	•	d			OAT	Calafat
3-Hydroxyphenanthrene	urine	•	•	•	•	d			OAT	Calafat
2 & 3-Hydroxyphenanthrene	urine					•	•	•	OAT	Calafat
4-Hydroxyphenanthrene	urine	•		•	•	•	•	•	OAT	Calafat
1-Hydroxypyrene	urine	•	•	•	•	•	•	•	OAT	Calafat
1-Hydroxynaphthalene (1-Naphthol)	urine	•	•	•	•	•	•	•	OAT	Calafat
2-Hydroxynaphthalene (2-Naphthol)	urine	•	•	•	•	•	•	•	OAT	Calafat
Volatile Organic Compounds (VOCs)										
Benzene	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Chlorobenzene	whole blood	•	•	•	•	•	•	•	TVB	Chambers
1,2-Dichlorobenzene	whole blood	•	•	•	•	•	•	•	TVB	Chambers
1,3-Dichlorobenzene	whole blood	•	•	•	•	•	•	•	TVB	Chambers
1,4-Dichlorobenzene (Paradichlorobenzene)	whole blood	•	•	•	•	•	•	•	TVB	Chambers
1,2-dibromo-3-chloropropane (DBCP)	whole blood	•	•	•	•	•	•	•	TVB	Chambers
2,5-Dimethylfuran	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Ethylbenzene	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Dichloromethane (Methylene chloride)	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Trichloroethene (Trichloroethylene)	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Tetrachloroethene (Perchloroethylene)	whole blood	•	•	•	•	•	•	•	TVB	Chambers
Dibromomethane	whole blood	•	•	•	•	d			TVB	Chambers
1,1-Dichloroethane	whole blood	•	•	•	•	d			TVB	Chambers
1,2-Dichloroethane (Ethylene dichloride)	whole blood	•	•	•	•	•	•	•	TVB	Chambers

1,1-Dichloroethene (Vinylidene chloride)	whole blood	•	•	•	•	d			TVB	Chambers	
<i>cis</i> -1,2-Dichloroethene	whole blood	•	•	•	•	d			TVB	Chambers	
<i>trans</i> -1,2-Dichloroethene	whole blood	•	•	•	•	d			TVB	Chambers	
1,2-Dichloropropane	whole blood	•	•	•	•	d			TVB	Chambers	
1,1,1-Trichloroethane (Methyl chloroform)	whole blood	•	•	•	•	•	•	•	TVB	Chambers	
1,1,2-Trichloroethane	whole blood	•	•	•	•	d			TVB	Chambers	
1,1,2,2-Tetrachloroethane	whole blood	•	•	•	•	d			TVB	Chambers	
Tetrachloromethane (Carbon tetrachloride)	whole blood	•	•	•	•	•	•	•	TVB	Chambers	
Hexachloroethane	whole blood	•	•	•	•	d			TVB	Chambers	
Diethylether	whole blood					•	•	•	TVB	Chambers	
Isobutyronitrile	whole blood					•	•	•	TVB	Chambers	
Methyl- <i>tert</i> -butyl ether (MTBE)	whole blood	•	•	•	•	•	•	•	TVB	Chambers	
Nitrobenzene	whole blood	•	•	•	•	•	•	•	TVB	Chambers	
Styrene	whole blood	•	•	•	•	•	•	•	TVB	Chambers	
Toluene	whole blood	•	•	•	•	•	•	•	TVB	Chambers	
<i>m</i> - <i>p</i> -Xylene	whole blood	•	•	•	•	•	•	•	TVB	Chambers	
<i>o</i> -Xylene	whole blood	•	•	•	•	•	•	•	TVB	Chambers	
Isopropylbenzene (Cumene)	whole blood		•	•	•	•	•	•	TVB	Chambers	
1,2-Dibromoethane	whole blood		•	•	•	•	•	•	TVB	Chambers	
1,4-Dioxane	whole blood		•	•	•	•	•	•	TVB	Chambers	
Furan	whole blood		•	•	•	•	•	•	TVB	Chambers	
<i>n</i> -Hexane	whole blood		•	•	•	•	•	•	TVB	Chambers	
Nitromethane	whole blood		•	•	•	d			TVB	Chambers	
1,1,1,2-Tetrachloroethane	whole blood		•	•	•	•	•	•	TVB	Chambers	
1,2,3-Trichloropropane	whole blood		•	•	•	•	•	•	TVB	Chambers	
AAA-Trifluorotoluene/ α,α,α -Trifluorotoluene	whole blood					•	•	•	TVB	Chambers	
Benzonitrile	whole blood					•	•	•	TVB	Chambers	
1-Bromopropane/Propyl bromide	whole blood					•	•	•	TVB	Chambers	
Chloroethane	whole blood					•	•	•	TVB	Chambers	
Cyclohexane	whole blood					•	•	•	TVB	Chambers	
Ethyl acetate	whole blood					•	•	•	TVB	Chambers	
Heptane	whole blood					•	•	•	TVB	Chambers	
Methyl isobutyl ketone	whole blood					•	•	•	TVB	Chambers	
Methylcyclopentane	whole blood					•	•	•	TVB	Chambers	
Octane	whole blood					•	•	•	TVB	Chambers	
Tetrahydrofuran	whole blood					•	•	•	TVB	Chambers	
Vinyl bromide	whole blood					•	•	•	TVB	Chambers	
Volatile Organic Compound Metabolites (VOC metabolites)											
N-Acetyl-S-(2-carbamoylethyl)-L-cysteine (AAMA)	urine	•				•	•	•	•	TVB	Alwis/ Chambers
N-Acetyl-S-(N-methylcarbamoyl)-L-cysteine (AMCA)	urine	•				•	•	•	•	TVB	Alwis
2-Aminothiazoline-4-carboxylic acid (ATCA)	urine	•				•	•	•	•	TVB	Alwis
N-Acetyl-S-(benzyl)-L-cysteine (BMA)	urine	•				•	•	•	•	TVB	Alwis
N-Acetyl-S-(<i>n</i> -propyl)-L-cysteine	urine	•				•	•	•	•	TVB	Alwis

(BPMA)										
N-Acetyl-S- (2-carboxyethyl)-L-cysteine (CEMA)	urine	•			•	•	•	•	TVB	Alwis
N-acetyl-S-(1-cyano-2-hydroxyethyl)-L-cysteine (CYHA)	urine						•	•	TVB	Alwis
N-Acetyl-S-(2-cyanoethyl)-L-cysteine (CYMA)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S-(1,2-dichlorovinyl)-L-cysteine (1DCV)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S-(2,2-dichlorovinyl)-L-cysteine (2DCV)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S- (3,4-dihydroxybutyl)-L-cysteine (DHBM)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S-(dimethylphenyl)-L-cysteine (DPMA)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine (GAMA)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S- (2-hydroxyethyl)-L-cysteine (HEMA)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S- (3-hydroxypropyl)-L-cysteine (HPMA)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S- (2-hydroxypropyl)-L-cysteine (HPM2)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S-(3-hydroxypropyl-1-methyl)-L-cysteine (HPMM)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S- (1-hydroxymethyl-2-propenyl)-L-cysteine (MHB1)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S- (2-hydroxy-3-butenyl)-L-cysteine (MHB2)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S- (4-hydroxy-2-butenyl)-L-cysteine (MHB3)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S-(phenyl-2-hydroxyethyl)-L-cysteine (PHEM)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S-(phenyl)-L-cysteine (PMA)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S-(trichlorovinyl)-L-cysteine (TCVM)	urine	•			•	•	•	•	TVB	Alwis
Mandelic acid (MADA)	urine	•			•	•	•	•	TVB	Alwis
2-Methylhippuric acid (2MHA)	urine	•			•	•	•	•	TVB	Alwis
3- & 4-Methylhippuric acid (34MH)	urine	•			•	•	•	•	TVB	Alwis
t,t-Muconic acid (MUCA)	urine	•			•	•	•	•	TVB	Alwis
Phenylglyoxylic acid (PHGA)	urine	•			•	•	•	•	TVB	Alwis
2-Thioxothiazolidine-4-carboxylic acid (TTCA)	urine	•			•	•	•	•	TVB	Alwis
N-Acetyl-S-(2-hydroxy-2-methyl-3-buten-1-yl)-L-cysteine (IPM2) + N-Acetyl-S-(2-hydroxy-3-methyl-3-buten-1-yl)-L-cysteine (IPM1)	urine						•	•	TVB	Alwis
N-Acetyl-S-(4-hydroxy-2-methyl-2-buten-1-yl)-L-cysteine (IPMA3)	urine							•	TVB	Alwis
N-Acetyl-S(((4-[Methylsulfinyl]butyl)amino)thioxomethyl)-L-cysteine (SUMA)	urine							•	TVB	Alwis
Diisocyanate metabolites and urinary amines										
2,4-Diaminotoluene (4TDA)	urine				• surplu s			•	•	Alwis/ Chambers
2,6-Diaminotoluene (6TDA)	urine				• surplu s			•	•	TVB
4,4'-Diaminodiphenylmethane (4MDA)	urine				• surplu			•	•	TVB

1,5-Diaminonaphthalene (5NDA)	urine					•	•	•	TVB	Alwis
<i>o</i> -Phenylenediamine (OPDA)	urine					•	•	•	TVB	Alwis
<i>p</i> -Phenylenediamine (PPDA)	urine					•	•	•	TVB	Alwis
5-Amino-1,3,3-trimethylcyclohexanemethylamine (IPDA)	urine					•	•	•	TVB	Alwis
Hexamethylenediamine (HAD)	urine					•	•	•	TVB	Alwis
β -N-Methylamino-L-alanine (BMAA)	urine					•	•	•	TVB	Alwis
Trimethylamine N-oxide (TMAO)	urine					•	•	•	TVB	Alwis
Tobacco Biomarkers: Cotinine and Nicotine Analogs										
Anabasine	urine					•	•	•	TVB	Feng/Wang
Anatabine	urine					•	•	•	TVB	Feng/Wang
Cotinine	serum	•	•	•	•	•	•	•	TVB	Sosnoff
Cotinine	urine					•	•	•	TVB	Feng/Wang
Cotinine-n-oxide	urine					•	•	•	TVB	Feng/Wang
Hydroxycotinine	serum					•	•	•	TVB	Sosnoff
Hydroxycotinine	urine					•	•	•	TVB	Feng/Wang
Norcotinine	urine					•	•	•	TVB	Feng/Wang
Nicotine-1'N-oxide	urine					•	•	•	TVB	Feng/Wang
Nornicotine	urine					•	•	•	TVB	Feng/Wang
Nicotine	urine					•	•	•	TVB	Feng/Wang
4-Hydroxy-4-(3-pyridyl) butanoic acid	urine							•	TVB	Feng/Wang
Tobacco Biomarkers: Aldehydes										
Acetaldehyde	serum					•	•	•	TVB	Silva/ Chambers
Acrolein	serum					•	•	•	TVB	Silva
Benzaldehyde	serum					•	•	•	TVB	Silva
Butyraldehyde	serum					•	•	•	TVB	Silva
Crotonaldehyde	serum					•	•	•	TVB	Silva
Decanal	serum					•	•	•	TVB	Silva
Furaldehyde	serum					•	•	•	TVB	Silva
Heptanal	serum					•	•	•	TVB	Silva
n-Hexanal	serum					•	•	•	TVB	Silva
Isobutyraldehyde	serum						•	•	TVB	Silva
Isovaleraldehyde (isopentaldehyde)	serum					•	•	•	TVB	Silva
Nonanal	serum					•	•	•	TVB	Silva
Octanal	serum					•	•	•	TVB	Silva
<i>o</i> -Tolualdehyde	serum					•	•	•	TVB	Silva
Pentanal	serum					•	•	•	TVB	Silva
Propionaldehyde	serum					•	•	•	TVB	Silva
Tobacco Biomarkers: Aromatic Amines										
1-Aminonaphthalene	urine							•	TVB	Seyler/ Wang

2-Aminonaphthalene	urine	surplus				•	•	•	TVB	Seyler/Wang
4-Aminobiphenyl	urine	surplus				•	•	•	TVB	Seyler/Wang
Anisidine	urine					•	•	•	TVB	Seyler/Wang
2,6-Dimethylaniline	urine					•	•	•	TVB	Seyler/Wang
Quinoline	urine					•	•	•	TVB	Seyler/Wang
<i>o</i> -Toluidine	urine	surplus				•	•	•	TVB	Seyler/Wang
Tobacco Biomarkers: Heterocyclic Amines										
3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole (Trp-P-1)	urine					•	d	•	TVB	Xia/Wang
2-Amino-3-methyl-9H-pyrido[2,3-b]indole (MeA- α -C)	urine					•	d	•	TVB	Xia
2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (Ph1P)	urine					•	d	•	TVB	Xia
2-Amino-9H-pyrido[2,3-b]indole (A- α -C)	urine					•	d	•	TVB	Xia
2-Amino-3-methylimidazo[4,5-f]quinoline (IQ)	urine					•	d	•	TVB	Xia
2-Amino-6-methyldipyrdo[1,2-a:3',2'-d]imidazole (Glu-P1)	urine					•	d	•	TVB	Xia
2-Aminodipyrdo[1,2-a:3',2'-d]imidazole (GLU-P2)	urine					•	d	•	TVB	Xia
Harman	urine					•	d	•	TVB	Xia
1-Methyl-3-amino-5H-pyrido[4,3-b]indole (Trp-P-2)	urine					•	d	•	TVB	Xia
Norharman	urine					•	d	•	TVB	Xia
Tobacco Biomarkers: TSNAs										
4-(Methylnitrosamino)-1-(3-pyridyl)-1-Butanol (NNAL)	urine		•	•	•	•	•	•	TVB	Xia/Wang
4-(Methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK)	urine					•	•	•	TVB	Xia
N'-Nitrosanabasine (NAB)	urine					•	•	•	TVB	Xia
N'-Nitrosanatabine (NAT)	urine					•	•	•	TVB	Xia
N'-Nitrosornicotine (NNN)	urine					•	•	•	TVB	Xia
Tobacco Biomarkers: Volatile N-Nitrosamines										
N-Nitrosodiethylamine (NDEA)	urine			surplu s		•	d	•	TVB	Seyler/Wang
N-nitrosodimethylamine (NDMA)	urine			surplu s		•	d	•	TVB	Seyler/Wang
N-Nitrosoethylmethylamine (NMEA)	urine			surplu s		•	d	•	TVB	Seyler/Wang
N-nitrosomorpholine (NMOR)	urine			surplu s		•	d	•	TVB	Seyler/Wang
N-Nitrosopiperidine (NPIP)	urine			surplu s		•	d	•	TVB	Seyler/Wang
N-Nitrosopyrrolidine (NPYR)	urine			surplu s		•	d	•	TVB	Seyler/Wang
trans Fatty Acids										
<i>trans</i> -9-Hexadecenoic acid	plasma			•	d				CCB	Vesper
<i>trans</i> -9-Octadecenoic acid	plasma			•	d				CCB	Vesper
<i>trans,trans</i> -9,12-Octadecadienoic acid	plasma			•	d				CCB	Vesper
<i>trans</i> -11-Octadecanoic acid	plasma			•	d				CCB	Vesper
Caffeine and Metabolites										
5-acetylamino-6-amino-3-methyluracil	urine			•	•	•	d		NBB	Ryback

1-methyluric acid	urine			•	•	•	d			NBB	Ryback
3-methyluric acid	urine			•	•	•	d			NBB	Ryback
7-methyluric acid	urine			•	•	•	d			NBB	Ryback
1,3-dimethyluric acid	urine			•	•	•	d			NBB	Ryback
1,7-dimethyluric acid	urine			•	•	•	d			NBB	Ryback
3,7-dimethyluric acid	urine			•	•	•	d			NBB	Ryback
1,3,7-trimethyluric acid	urine			•	•	•	d			NBB	Ryback
1-methylxanthine	urine			•	•	•	d			NBB	Ryback
3-methylxanthine	urine			•	•	•	d			NBB	Ryback
7-methylxanthine	urine			•	•	•	d			NBB	Ryback
1,3-dimethylxanthine (theophylline)	urine			•	•	•	d			NBB	Ryback
1,7-dimethylxanthine (paraxanthine)	urine			•	•	•	d			NBB	Ryback
3,7-dimethylxanthine (theobromine)	urine			•	•	•	d			NBB	Ryback
1,3,7-trimethylxanthine (caffeine)	urine			•	•	•	d			NBB	Ryback
Iron-Status and Inflammation Indicators											
Ferritin	serum	•	•	•	d			•	•	NBB	Pfeiffer
Transferrin receptor	serum	•	•	•	d			•	•	NBB	Pfeiffer
Iron	serum									NBB	Pfeiffer
TIBC	serum									NBB	Pfeiffer
Transferrin saturation	serum									NBB	Pfeiffer
Protoporphyrin	serum									NBB	Pfeiffer
Water Soluble Vitamins and Related Compounds											
Folate (serum)	serum	•	•	•	d					NBB	Pfeiffer
Folate (RBC)	RBC	•	•	•	•	•	•	•	•	NBB	Pfeiffer
Folate forms by LC-MS/MS (serum)											
Total folate (calculated)					•	•	•	•		NBB	Pfeiffer
5-Methyltetrahydrofolate	serum		•		•	•	•	•		NBB	Pfeiffer
Folic acid	serum		•		•	•	•	•		NBB	Pfeiffer
5-Formyltetrahydrofolate	serum				•	•	•	•		NBB	Pfeiffer
Tetrahydrofolate	serum				•	•	•	•		NBB	Pfeiffer
5,10-Methenyltetrahydrofolate	serum				•	•	•	•		NBB	Pfeiffer
MeFox oxidation product	serum				•	•	•	•		NBB	Pfeiffer
Homocysteine	plasma	•	d							NBB	Pfeiffer
Methylmalonic acid	plasma/ serum	d			•	•	d			NBB	Pfeiffer
Vitamin B12	serum	•			•	•	d			NBB	Pfeiffer
Vitamin B6 (pyridoxal-5'-phosphate)	serum	•	•	•	d					NBB	Pfeiffer
Vitamin B6 (4-pyridoxic acid)	serum	•	•	•	d					NBB	Pfeiffer
Vitamin C (ascorbic acid)	serum	•	d					•		NBB	Pfeiffer
Fat-Soluble Vitamins and Micronutrients											
Vitamin A	serum	•	d					•		NBB	Schleicher
Vitamin E	serum	•	d					•		NBB	Schleicher
Retinyl palmitate	serum	•	d					•		NBB	Schleicher
Retinyl stearate	serum	•	d					•		NBB	Schleicher
<i>gamma</i> -Tocopherol	serum	•	d					•		NBB	Schleicher
<i>alpha</i> -carotene	serum	•	d					•		NBB	Schleicher

<i>trans</i> -beta-Carotene	serum	•	d					•	NBB	Schleicher
<i>cis</i> -beta-Carotene	serum	•	d					•	NBB	Schleicher
<i>alpha</i> -Cryptoxanthin	serum							•	NBB	Schleicher
<i>beta</i> -Cryptoxanthin	serum	•	d					•	NBB	Schleicher
Lutein/zeaxanthin	serum	•	d					•	NBB	Schleicher
<i>trans</i> -Lycopene	serum	•	d					•	NBB	Schleicher
Total lycopene	serum	•	d					•	NBB	Schleicher
25-OH Vitamin D (D2 + D3)	serum	•	•	•	•	•	•	•	NBB	Schleicher
25-OH Vitamin D2	serum		•	•	•	•	•	•	NBB	Schleicher
25-OH Vitamin D3	serum		•	•	•	•	•	•	NBB	Schleicher
epimer-25-OH Vitamin D3	serum		•	•	•	•	•	•	NBB	Schleicher
Fatty acids (30)										
Capric acid (C10:0)	plasma /serum				•	•	d		NBB	Schleicher
Lauric acid (C12:0)	plasma /serum				•	•	d		NBB	Schleicher
Myristic acid (14:0)	plasma /serum				•	•	d		NBB	Schleicher
Pentadecanoic acid (C15:0)	plasma /serum				•	•	d		NBB	Schleicher
Palmitic acid (16:0)	plasma /serum				•	•	d		NBB	Schleicher
Margaric acid (C17:0)	plasma /serum				•	•	d		NBB	Schleicher
Stearic acid (18:0)	plasma /serum				•	•	d		NBB	Schleicher
Arachidic acid (20:0)	plasma /serum				•	•	d		NBB	Schleicher
Docosanoic acid (22:0)	plasma /serum				•	•	d		NBB	Schleicher
Tricosanoic acid (C23:0)	plasma /serum				•	•	d		NBB	Schleicher
Lignoceric acid (24:0)	plasma /serum				•	•	d		NBB	Schleicher
Myristoleic acid (14:1n-5)	plasma /serum				•	•	d		NBB	Schleicher
Palmitoleic acid (16:1n-7)	plasma /serum				•	•	d		NBB	Schleicher
<i>cis</i> -Vaccenic acid (18:1n-7)	plasma /serum				•	•	d		NBB	Schleicher
Oleic acid (18:1n-9)	plasma /serum				•	•	d		NBB	Schleicher
Eicosenoic acid (20:1n-9)	plasma /serum				•	•	d		NBB	Schleicher
Docosenoic acid (22:1n-9)	plasma /serum				d				NBB	Schleicher
Nervonic acid (24:1n-9)	plasma /serum				•	•	d		NBB	Schleicher
Linoleic acid (18:2n-6)	plasma /serum				•	•	d		NBB	Schleicher
<i>alpha</i> -Linolenic acid (18:3n-3)	plasma /serum				•	•	d		NBB	Schleicher
<i>gamma</i> -Linolenic acid (18:3n-6)	plasma /serum				•	•	d		NBB	Schleicher
Stearidonic acid (C18:4n-3)	plasma /serum				•	•	d		NBB	Schleicher
Eicosadienoic acid (20:2n-6)	plasma /serum				•	•	d		NBB	Schleicher
homo- <i>gamma</i> -Linolenic acid (20:3n-6)	plasma /serum				•	•	d		NBB	Schleicher
Eicosatrienoic acid (C20:3n-9)	plasma /serum				•	•	d		NBB	Schleicher
Arachidonic acid (20:4n-6)	plasma /serum				•	•	d		NBB	Schleicher
Eicosapentaenoic acid (20:5n-3)	plasma /serum				•	•	d		NBB	Schleicher

Docosatetraenoic acid (22:4n-6)	plasma /serum				•	•	d		NBB	Schleicher
Docosapentaenoic acid (22:5n-3)	plasma /serum				•	•	d		NBB	Schleicher
Docosapentaenoic acid (22:5n-6)	plasma /serum				•	•	d		NBB	Schleicher
Docosahexaenoic acid (22:6n-3)	plasma /serum				•	•	d		NBB	Schleicher
Hormones and Binding Protein										
Estradiol	serum					•	•	d	CCB	Vesper
Testosterone	serum				•	•	•	d	CCB	Vesper
Steroid Hormone Binding Globulin	serum					•	•	d	CCB	Vesper