Supporting Information

Fluorinated compounds in North American cosmetics

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Content of Supporting Information:
36 pages (including cover sheet)
16 Tables
2 Figures

Instrumental analyses

PIGE Data normalization.

Several measures were taken to ensure that data acquired at Hope College in 2016, and at the University of Notre Dame in 2020 are compatible. Sets of data from each time period were normalized to one another by comparing the total F counts given from sets of fluorinated paper samples analyzed at both locations/times. Samples with total F counts near or below the LOD for PIGE (highlighted gray in Table S3) were excluded from the average calculation. The coefficient of determination for 2016 vs 2020 was r^2= 0.9628 and for 2018 vs 2020 r^2= 0.9976, signaling a small variance between the total F counts of samples taken at separate time points. The average conversion factor for each set revealed that PIGE total F counts from ND2020 were 2.7±0.4 times higher than Hope2016 and 2.2±0.2 times higher than ND2018 (see Table S3) as detector efficiency and beam optimization occurred. These factors were used to normalize PIGE counts from Hope2016 and ND2018 to the same scale as ND2020.

PIGE Analysis

Additional information on PIGE instrumentation and analysis is reported elsewhere.[1-4] At both facilities/times a blank target frame was measured for each batch of ~50-60 samples to confirm a clean background. Each sample was irradiated with approximately 10-50 nanoamperes of 3.4 or 3.9 megaelectron-volts (MeV) protons for 180 seconds. The beam was extracted *ex vacuo* through a thin (8 μm) Kapton® foil and impinged on each target in air, through the center hole of each target frame. The characteristic gamma-rays emitted from the de-excitation of ^{19}F at 110 keV and 197 keV had background-subtracted integrations summed for each sample irradiation. In addition, all the data collected in a day (typically one or two batches) were normalized to the 770 keV gamma ray that comes from the interaction of the beam on air before it strikes the target.[2] In order to transform the argon-normalized integrated gamma-ray counts in the 110 and 197 keV peaks per microcoulomb of beam on target (counts/μC) into a F concentration in μg F/cm^2, a set of paper-based external inorganic fluorine standards were utilized. Solutions of sodium fluoride were prepared at concentrations from 0-750 μg/mL. 0.3 mL of prepared solutions were pipetted onto 42.5 mm diameter Whatman 1 filter papers (Cat No. 1001-042). The papers were allowed to dry and the amount of fluorine added was calculated as the μg of fluorine added per the area of the paper circles. The concentrations in μg F/cm^2 were plotted against the argon-normalized counts per microcoulomb for each standard and a linear fit was applied. The LINEST function was used on these standards to determine the limit of detection (LOD) and limit of quantification (LOQ) for PIGE analysis of total F (see Figure S1). The LOD was calculated as 3.3 times the standard error in the response divided by the slope. LOQ was calculated as 10 times the standard error in the response divided by the slope. The LOD and LOQ were found to be 0.127 and 0.384 μg F/cm^2 respectively and these values were utilized to define a sample as containing low F (<0.127 μg F/cm^2), moderate F (>0.127, <0.384 μg F/cm^2), and high F >0.384 μg F/cm^2).

Targeted Analysis using LC-MS/MS and GC-MS

50-100 mg of product was spiked with surrogate standards before sonicating twice with 3 mL of 4:1 hexane-isopropanol and twice with 3 mL of 1:1 methanol-acetonitrile. Supernatants were combined and concentrated to a final volume of 5 mL under nitrogen. Concentrates were vortexed and centrifuged with 100 mg of Envi-Carb for clean-up, concentrated again under nitrogen, and filtered. Filtrate was transferred to polypropylene vials and spiked with internal

standards for quantitation. LC-MS/MS analysis was done using an ultrahigh performance LC coupled with a triple-quadrupole MS (Agilent 1290 Infinity II UPLC – 6470 QQQ-MS) in negative electrospray ionization mode. GC-MS analysis was performed on an Agilent 7890 GC – 5977B PCI-MS operated in the positive chemical ionization mode. Additional instrumental parameters can be found in the Supporting Information of Wu *et al.* (2020).[5] A procedural blank and a matrix spike sample were processed along with each batch samples to evaluate possible contamination from laboratory operations and the performance of our method. The recoveries of surrogate standards were all in the range of 60-130%. Samples were corrected for recovery using the appropriate surrogate standards (see Table S7). After this correction, matrix spike recoveries of individual analytes were all within 80-115%. Additionally, data reported in this study were blank corrected by subtracting the corresponding average blank on a mass basis. The Method Detection Limits (MDLs) were defined as the average procedural blank + 3 × standard deviation (n = 5) or the amount of chemical generating a signal-to-noise of 5 if the compound was not detected in the procedural blanks.

Collection and analysis of ingredient labels chosen for targeted analysis

Ingredient lists were collected for the U.S. products chosen for targeted analysis. Ingredient lists for each product were accessed online in 2020-2021 from the retailers where products were purchased. Information on the chemical structures, properties and described uses of ingredients were determined using INCIDecoder.com and EWG's Skin Deep database.[6, 7] Publicly available industrial reports and brochures were also utilized. All ingredients were tabulated, including those listed as "may or may not be present". Tables S14-S16 below focus on these results. Table S14 lists the 62 ingredients and their described use in cosmetics that were reported at least two times on the ingredient lists of U.S. products selected for targeted analysis. The remaining 104 ingredients were only detected once and are given in Table S15. Table S16 gives a heatmap relating all ingredients listed in the U.S. products selected for targeted analysis to the number of times the ingredient was found in each category of F concentrations identified by PIGE. This heatmap reveals both fluorine-free and fluorinated ingredients that were found in nearly all products surveyed. Ingredients such as water, isododecane, and phenoxyethanol were commonly found in all categories of F concentrations but are unlikely to be fluorinated. These represent ingredients that are likely essential to the composition of cosmetic products. Probable inorganic sources of fluorine include disteardimonium hectorite and synthetic fluorphlogopite, both of which were more commonly found in products with high F concentrations. Ingredients such as methicone and dimethicone, acrylate and methacrylate, and silicone polymers were commonly reported. Fluorinated versions of these ingredients have been reported in literature as shown in Table S14. Many ingredient labels contained polymeric compounds unique to that product but have chemical structures similar to the generalized methicone, dimethicone, acrylate, methacrylate, and silicone polymers reported on multiple products.

Table S1. Breakdown of cosmetic categories tested based on the category description and the types of products surveyed in that category. Products were assigned to a category based on the intended use of the product as defined by the manufacturer.

Code	Category	Category Description	Products surveyed
L	Lips	Products designed for direct application onto lips	Sticks, glosses, shadows, liners, shimmers, balms
F	Foundation	Any cream or liquid foundation, not including powdered foundations	Liquids, creams
E	Eyes	Any product designed for application around the eyes, not including any mascara or eyelash, or eyebrow-specific products	Shadows, liquid and cream liners, creams, primers, pencils
M	Mascara	Any product designed for application directly onto the eyelashes	Standard, waterproof, primers
Fa	Face	Any product designed for application onto the skin of the face, not including cream or liquid foundations, or concealers	Powdered foundation, powders, blush, highlighters, bronzers, primers, finishing and priming sprays
C	Concealer	Any product designed for application directly onto the skin to act as a "concealer" for blemishes or pigmentation	Liquid, creams, sticks
Eb	Eyebrow	Any product designed for application directly onto eyebrows	Gels, pencils, shadows
Mi	Miscellaneous	Includes skin care, hair, and nail products	Face masks, moisturizer, hair spray, nail polish

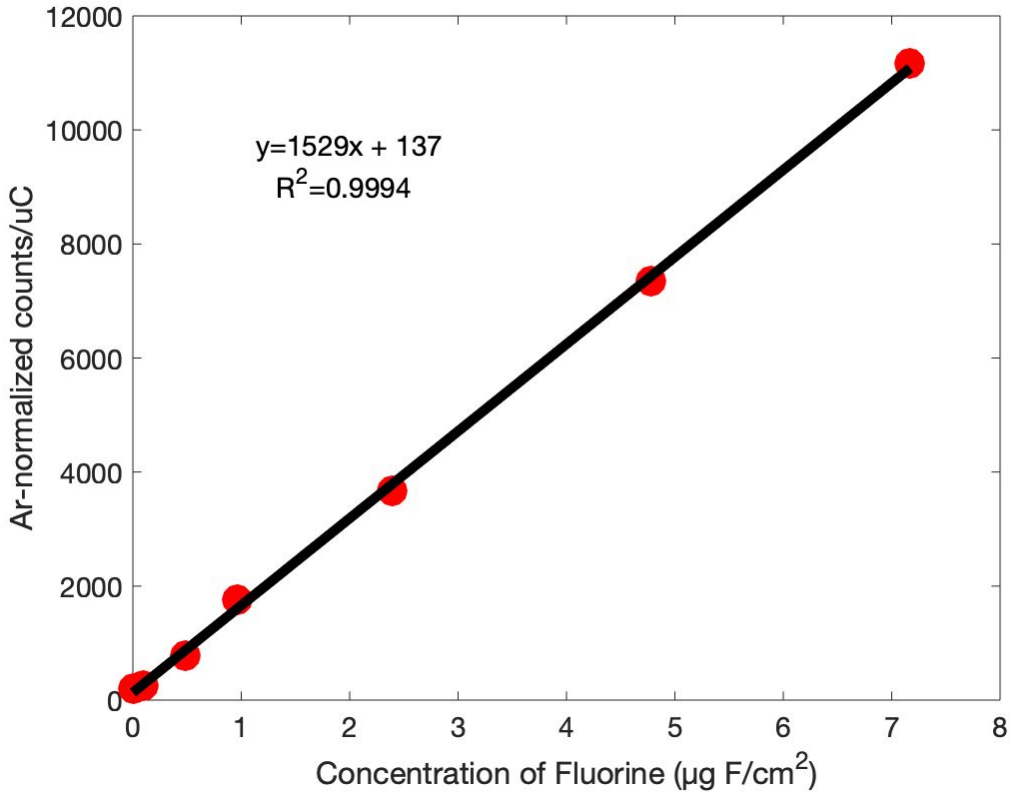
Table S2. List of cosmetic brands and cosmetic category of the products selected for PIGE analysis. See Table S1 for a breakdown of cosmetic category codes. Brands for all products are shown below, including those for products that showed low, moderate, and high fluorine levels. On some occasions one cosmetic category contained multiple products from the same brand for analysis. The table below does not contain information on the frequency any individual brand was tested, or the individual product names or shades selected for analysis. Brands with individual products that were entirely collected in Canada are highlighted in green. Brands with individual products collected in both Canada and the U.S. are highlighted in yellow.

Brand	Categories	Brand	Categories
Almay	F	Lorac	E,L
Anastasia Beverly Hills	F,L	MAC	L,M
Annabelle	F	Makeup Forever	F
Bare Minerals	F,Fa	Mally	Eb, E, L
Bath and Body Works	L	Marc Jacobs	E
Benefit	F,M	Maybelline	E,Fa,F,L,M
Burt's Bees	L	Merle Norman	F
Butter London	M	Milani	L
Buxom	E	MILK	F
Clinique	L,M,F	NARS	F,L
Cover Fx	F	Neutrogena	Fa
Covergirl	E,Fa,F,M	Nudestix	L
Dermablend	C,Fa,F	NYC New York City	L
Elf	C,E,Fa,F,L	NYX	Eb,E,Fa,L,F
Essence	L,M	Perricone	M
Estee Lauder	L,M	Physicians Formula	M
Fenty Beauty	F	Pur	C,E,F,Fa,L,M
Formula 10.0.6	Mi	Revlon	E,F,L
H&M	L	Rimmel London	E,L
Huda Beauty	F	Sally Hansen	Mi
IT Cosmettics	F	Sephora Beauty	F,C,M
Jeffree Star	L	Smashbox	C,Eb,Fa,F,L,M
John Frieda	Mi	Soap & Glory	Mi
Josie Maran	F	Stila	L
Juice Beauty	C,E,Fa,L,M	Tarte	C,Eb,Fa,F,L,M
Julep	L,M	theBlam	F
Juvias Place	F	Too Faced	E,Fa,F,L,M,Mi
Kat Von D	L	Ulta Beauty	E,Fa,L
L'Oreal	F,L	Urban Decay	Eb,E,F,L,M
Lancome	F	Wet n Wild	E,F,L,M
Laura Geller	C,E,Fa,F,L,M	XO Beauty	L
Lip Smacker	L	Yes to	Mi

Table S3. Data utilized to normalize PIGE data sets collected at Hope College (2016), and Notre Dame at two different time points (2018 and 2020). Samples where the conversion factor is given as N/A are those whose counts are below the detection limit for PIGE.

Hope 2016 vs ND 2020					
Sample ID	Counts/μC		Conversion Factor	Average	Standard Deviation
	2016	2020			
BK-MI-2-3	736	1800	2.5	2.7	0.4
CA-DC-1-4	843	2260	2.7		
CJ-1-4-1	105	250	2.4		
CP-DC-1-1	147	482	3.3		
JJ-MI-1-1	1170	3060	2.6		
ST-MI-1-5	1360	3010	2.2		
TT-2-1-3	717	2230	3.1		
TB-MI-1-5	73	80	N/A		
ND 2018 VS ND 2020					

Figure S1. Plot of fluorine concentrations in µg F/cm^2 versus the argon-normalized counts per microcoulomb with a linear regression. The regression function was used to determine the LOD and LOQ. 5 replicate runs of a paper standard at 2.87 µg F/cm^2 were used to determine the precision and accuracy. The relative standard deviation among these samples was 18.6% and the measured concentration was found to be 0.8% different than the expected concentration.



157 Table S4. List of analytes included in targeted analysis for both LC-MS/MS and GC-MS along with their Instrument Detection Limits
158 (IDL). A description of the calculation of Method Detection Limits (MDLs) are given in the Instrumental Analyses section above. The
159 MDLs ranged from 0.01 ng/g for pefluoropentanesulfonic acid (PFPeS) to 12.0 ng/g for 2-perfluorooctyl ethanol (8:2) (8:2 FTOH

LC-MS/MS								GC-MS	
Analyte	IDL (ng)	Analyte	IDL (ng)	Analyte	IDL (ng)	Analyte	IDL (ng)	Analyte	IDL (ng)
PFPrA	0.008	PFTeDA	0.007	PFECHS	0.003	FHxSA	0.003	4:2 FTOH	0.37
PFBA	0.01	PFHxDA	0.01	Cl-PFOS	0.005	FOSA	0.003	6:2 FTOH	0.22
PFPeA	0.009	GenX	0.62	6:2 FTCA	0.076	MeFOSA	0.004	8:2 FTOH	0.16
PFHxA	0.007	PFPrS	0.007	8:2 FTCA	0.08	EtFOSA	0.002	10:2 FTOH	0.22
PFHpA	0.005	PFBS	0.001	10:2 FTCA	0.074	6:2 PAP	0.03	MeFOSE	0.23
PFOA	0.004	PFPeS	0.001	4:2 FTSA	0.003	8:2 PAP	0.028	EtFOSE	0.22
PFNA	0.007	PFHxS	0.002	6:2 FTSA	0.005	6:2 diPAP	0.002	6:2 FTAc	0.032
PFDA	0.007	PFHpS	0.005	8:2 FTSA	0.003	6:2/8:2 diPAP	0.001	8:2 FTAc	0.039
PFUnDA	0.006	PFOS	0.005	6:2 Cl-PFESA	0.002	8:2 diPAP	0.001	10:2 FTAc	0.041
PFDoDA	0.009	PFNS	0.002	8:2 Cl-PFESA	0.004			6:2 FTMAc	0.031
PFTrDA	0.006	PFDS	0.008	FBSA	0.002			8:2 FTMAc	0.034

160 Table S5: List of targeted PFAS measured by LC-MS/MS.
161

Abbr.	Compound Name	CAS #	Formula	Retention time (min)	Mol. Wt.	Precursor ion [M-H/D]-	Fragmentor (volts)	Product ions (m/z)	Collision energy (volts)	Structure
PFPrA	Perfluoropropanoic acid	422-64-0	$C_3HF_5O_2$	0.532	164.03	162.9	64	119.0	5	F_3CCF_2COOH
PFBA	Perfluorobutanoic acid	375-22-4	$C_4HF_7O_2$	2.243	214.04	213.0	64	169	5	$F_3C(CF_2)_2COOH$
PFPeA	Perfluoropentanoic acid	2706-90-3	$C_5HF_9O_2$	3.518	264.05	263.0	64	218.9 140.8	5 5	$F_3C(CF_2)_3COOH$
PFHxA	Perfluoro-n-hexanoic acid	307-24-4	$C_6HF_{11}O_2$	5.008	314.05	313.0	73	268.9 119	5 21	$F_3C(CF_2)_4COOH$
PFHpA	Perfluoro-n-heptanoic acid	375-85-9	$C_7HF_{13}O_2$	6.646	364.06	363.0	78	319 169	5 17	$F_3C(CF_2)_5COOH$
PFOA	Perfluoro-n-octanoic acid	335-67-1	$C_8HF_{15}O_2$	8.186	414.07	413.1	83	369 169	5 17	$F_3C(CF_2)_6COOH$
PFNA	Perfluoro-n-nonanoic acid	375-95-1	$C_9HF_{17}O_2$	9.542	464.08	463.1	83	419 218.9	5 17	$F_3C(CF_2)_7COOH$
PFDA	Perfluoro-n-decanoic acid	335-76-2	$C_{10}HF_{19}O_2$	10.712	514.08	513.0	93	468.9 269	5 17	$F_3C(CF_2)_8COOH$
PFUnDA	Perfluoro-n-undecanoic acid	2058-94-8	$C_{11}HF_{21}O_2$	11.725	564.09	563.0	102	518.9 268.9	5 17	$F_3C(CF_2)_9COOH$
PFDoDA	Perfluoro-n-dodecanoic acid	307-55-1	$C_{12}HF_{23}O_2$	12.601	614.10	613.0	102	569 269	9 21	$F_3C(CF_2)_{10}COOH$

Abbr.	Compound Name	CAS #	Formula	Retention time (min)	Mol. Wt.	Precursor ion [M-H/D]-	Fragmentor (volts)	Product ions (m/z)	Collision energy (volts)	Structure
PFTrDA	Perfluoro-n-tridecanoic acid	72629-94-8	$C_{13}HF_{25}O_2$	13.347	664.11	663.1	107	619 169	9 29	$F_3C(CF_2)_{11}COOH$
PFTeDA	Perfluoro-n-tetradecanoic acid	376-06-7	$C_{14}HF_{27}O_2$	13.998	714.11	713.1	112	668.9 169	13 29	$F_3C(CF_2)_{12}COOH$
PFHxDA	Perfluoro-n-hexadecanoic acid	67905-19-5	$C_{16}HF_{31}O_2$	15.041	814.13	813.1	121	768.9 168.9	13 37	$F_3C(CF_2)_{14}COOH$
Gen X	Perfluoro-2-propoxypropanoic acid	13252-13-6	$C_6HF_{11}O_3$	5.866	330.05	329.0	156	284.9 169.0	5 13	$F_3C(CF_2)_2OCF(COOH)CF_3$
PFPrS	Perfluoro-1-propanesulfonic acid	423-41-6	$C_3HF_7SO_3$	2.748	250.09	249.1	140	80 98.9	37 33	$F_3C(CF_2)_2SO_3H$
PFBS	Perfluoro-1-butanesulfonic acid	375-73-5	$C_4HF_9SO_3$	3.876	300.10	299.0	149	80 98.9	37 37	$F_3C(CF_2)_3SO_3H$
PFPeS	Perfluoro-1-pentanesulfonic acid	2706-91-4	$C_5HF_{11}SO_3$	5.336	350.11	349.0	175	80 98.9	45 37	$F_3C(CF_2)_4SO_3H$
PFHxS	Perfluoro-1-hexanesulfonic acid	355-46-4	$C_6HF_{13}SO_3$	6.885	400.11	399.0	179	80 98.9	45 41	$F_3C(CF_2)_5SO_3H$
PFHpS	Perfluoro-1-heptanesulfonic acid	375-92-8	$C_7HF_{15}SO_3$	8.357	450.12	449.0	183	80 98.9	49 45	$F_3C(CF_2)_6SO_3H$
PFOS	Perfluoro-1-octanesulfonic acid	1763-23-1	$C_8HF_{17}SO_3$	9.647	500.13	499.0	208	80 98.9	101 49	$F_3C(CF_2)_7SO_3H$

Abbr.	Compound Name	CAS #	Formula	Retention time (min)	Mol. Wt.	Precursor ion [M-H/D]-	Fragmentor (volts)	Product ions (m/z)	Collision energy (volts)	Structure
PFNS	Perfluoro-1-nonanesulfonic acid	68259-12-1	$C_9HF_{19}SO_3$	10.776	549.93	549.0	218	80 98.9	105 49	$F_3C(CF_2)_8SO_3H$
PFDS	Perfluoro-1-decanesulfonic acid	335-77-3	$C_{10}HF_{21}SO_3$	11.764	600.14	598.9	232	80 98.9	137 53	$F_3C(CF_2)_9SO_3H$
PFECHS	Perfluoro-4-ethylcyclohexanesulfonic acid	646-83-3	$C_8HF_{15}SO_3$	8.096	462.13	461.0	150	380.9 98.9	29 29	$F_5C_2(C_6F_{10})$ (*para*-) SO_3H
Cl-PFOS	8-Chloroperfluoro-1-octanesulfonic acid	777011-38-8	$C_8HF_{16}ClSO_3$	9.897	516.58	515.0	203	80 98.9	105 49	$ClF_2C(CF_2)_7SO_3H$
6:2 Cl-PFESA	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	$C_8HClF_{16}O_4S$	9.379	532.58	530.9	161	350.9 83.0	29 29	$ClF_2C(CF_2)_5O(CF_2)_2SO_3H$
8:2 Cl-PFESA	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	$C_{10}HClF_{20}O_4S$	10.812	632.60	630.9	171	450.9 83.0	33 33	$ClF_2C(CF_2)_7O(CF_2)_2SO_3H$
FBSA	Perfluoro-1-butanesulfonamide	30334-69-1	$C_4H_2F_9NO_2S$	5.002	299.12	298.0	98	78.0 48.1	25 93	$F_3C(CF_2)_3SO_2NH_2$
FHxSA	Perfluoro-1-hexanesulfonamide	41997-13-1	$C_6H_2F_{13}NO_2S$	8.226	399.13	397.9	117	78.0 48.1	29 100	$F_3C(CF_2)_5SO_2NH_2$
FOSA	Perfluoro-1-octanesulfonamide	754-91-6	$C_8H_2F_{17}NO_2S$	11.159	499.14	498.0	169	78 48.1	37 150	$F_3C(CF_2)_7SO_2NH_2$
MeFOSA	N-methylperfluoro-1-octanesulfonamide	31506-32-8	$C_9H_4F_{17}NO_2S$	12.808	513.17	512.0	160	169 218.9	29 25	$F_3C(CF_2)_7SO_2NHCH_3$

Abbr.	Compound Name	CAS #	Formula	Retention time (min)	Mol. Wt.	Precursor ion [M-H/D]-	Fragmentor (volts)	Product ions (m/z)	Collision energy (volts)	Structure
EtFOSA	N-ethylperfluoro-1-octanesulfonamide	4151-50-2	$C_{10}H_6F_{17}NO_2S$	13.375	527.20	526.0	165	169 219	29 29	$F_3C(CF_2)_7SO_2NHC_2H_5$
6:2 FTCA	2-Perfluorohexyl ethanoic acid (6:2)	53826-12-3	$C_8H_3F_{13}O_2$	7.037	378.09	377.0	185	292.9 63.1	15 3	$F_3C(CF_2)_5CH_2COOH$
8:2 FTCA	2-Perfluorooctyl ethanoic acid (8:2)	27854-31-5	$C_{10}H_3F_{17}O_2$	9.927	478.10	477.0	215	392.9 63	15 3	$F_3C(CF_2)_7CH_2COOH$
10:2 FTCA	2-Perfluorodecyl ethanoic acid (10:2)	53826-13-4	$C_{12}H_3F_{21}O_2$	12.075	578.12	577.0	245	492.9 63	15 3	$F_3C(CF_2)_9CH_2COOH$
4:2 FTSA	1H,1H,2H,2H-perfluorohexane sulfonic acid (4:2)	757124-72-4	$C_6H_5F_9O_3S$	4.870	328.15	327.1	136	306.9 81	21 33	$F_3C(CF_2)_3(CH_2)_2SO_3H$
6:2 FTSA	1H,1H,2H,2H-perfluorooctane sulfonic acid (6:2)	27619-97-2	$C_8H_5F_{13}O_3S$	8.091	428.17	427.0	164	406.9 81	25 41	$F_3C(CF_2)_5(CH_2)_2SO_3H$
8:2 FTSA	1H,1H,2H,2H-perfluorodecane sulfonic acid (8:2)	39108-34-4	$C_{10}H_5F_{17}O_3S$	10.676	528.18	527.0	179	506.9 81	29 41	$F_3C(CF_2)_7(CH_2)_2SO_3H$
6:2 PAP	1H,1H,2H,2H-perfluorooctylphosphate	57678-01-0	$C_8H_6F_{13}O_4P$	3.513	444.08	443.0	108	97.0 79.0	17 100	$(O)P(OH)_2[O(CH_2)_2(CF_2)_5CF_3]$
8:2 PAP	1H,1H,2H,2H-perfluorodecylphosphate	57678-03-2	$C_{10}H_6F_{17}O_4P$	4.306	544.08	543.0	108	97.0 79.0	21 93	$(O)P(OH)_2[O(CH_2)_2(CF_2)_7CF_3]$
6:2 diPAP	Bis(1H,1H,2H,2H-perfluorooctyl)phosphate	57677-95-9	$C_{16}H_9F_{26}O_4P$	5.289	790.17	789.0	132	442.9 97.0	17 37	$(O)P(OH)[O(CH_2)_2(CF_2)_5CF_3]_2$

Abbr.	Compound Name	CAS #	Formula	Retention time (min)	Mol. Wt.	Precursor ion [M-H/D]-	Fragmentor (volts)	Product ions (m/z)	Collision energy (volts)	Structure
6:2/8:2 diPAP	(1H,1H,2H,2H-perfluorooctyl-1H,1H,2H,2H-perfluorodecyl)phosphate	943913-15-3	$C_{18}H_9F_{30}O_4P$	5.478	890.20	889.0	156	443.0 96.9	21 33	$(O)P(OH)[O(CH_2)_2(CF_2)_5CF_3][O(CH_2)_2(CF_2)_7CF_3]$
8:2 diPAP	Bis(1H,1H,2H,2H-perfluorodecyl)phosphate	678-41-1	$C_{20}H_9F_{34}O_4P$	5.622	990.20	989.0	151	542.9 97.0	25 37	$(O)P(OH)[O(CH_2)_2(CF_2)_7CF_3]_2$
M3PFBA (surrogate standard, SS)	Perfluoro-n-[2,3,4-$^{13}C_3$]butanoic acid		CHF_7O_2 + $^{13}C_3$	2.242	217.04	216.0	64	172	5	
MPFHxA (SS)	Perfluoro-n-[1,2-$^{13}C_2$]hexanoic acid		$C_4HF_{11}O_2$ + $^{13}C_2$	4.999	316.05	315.1	78	270	5	
MPFOA (SS)	Perfluoro-n-[1,2,3,4-$^{13}C_4$]octanoic acid		$C_4HF_{15}O_2$ + $^{13}C_4$	8.185	418.07	417.1	83	372	5	
MPFUnDA (SS)	Perfluoro-n-[1,2-$^{13}C_2$]undecanoic acid		$C_9HF_{21}O_2$ + $^{13}C_2$	11.725	566.09	565.1	97	520	9	
M2PFTeDA (SS)	Perfluoro-n-[1,2-$^{13}C_2$]tetradecanoic acid		$C_{12}HF_{27}O_2$ + $^{13}C_2$	13.997	716.11	715.1	116	669.9	13	
M3PFBS (SS)	Perfluoro-1-[2,3,4-$^{13}C_3$]butanesulfonic acid		CHF_9SO_3 + $^{13}C_3$	3.874	303.10	302.0	149	80	45	
MPFHxS (SS)	Perfluoro-1-hexane[$^{18}O_2$]sulfonic acid		$C_6HF_{13}SO$ + $^{18}O_2$	6.882	404.11	403.0	169	84	49	
MPFOS (SS)	Perfluoro-1-[1,2,3,4-$^{13}C_4$]octanesulfonic acid		$C_4HF_{17}SO_3$ + $^{13}C_4$	9.646	504.13	503.0	198	80	93	
dMeFOSA (SS)	N-methyl-d_3-perfluoro-1-octanesulfonamide		$C_9HF_{17}NO_2S$ + D_3	12.799	516.17	515.0	160	169	29	
M2-8:2 FTCA (SS)	2-Perfluorooctyl-[1,2-$^{13}C_2$]-ethanoic acid(8:2)		$C_8H_3F_{17}O_2$ + $^{13}C_2$	9.926	480.10	479.0	215	394	11	
M2-8:2 FTSA (SS)	1H,1H,2H,2H-perfluoro-1-[1,2-$^{13}C_2$]-decane sulfonic acid (8:2)		$C_8H_5F_{17}O_3S$ + $^{13}C_2$	10.675	530.18	529.0	195	509	33	
M2-8:2 PAP (SS)	1H,1H,2H,2H-[1,2-$^{13}C_2$]perfluorodecylphosphate		$C_8H_6F_{17}O_4P$ + $^{13}C_2$	4.305	546.08	545.0	113	97.0	17	
MPFBA (internal standard, IS)	Perfluoro-n-[1,2,3,4-$^{13}C_4$]butanoic acid		HF_7O_2 + $^{13}C_4$	2.240	218.04	217.0	64	172	5	
M8PFOA (IS)	Perfluoro-n-[$^{13}C_8$]octanoic acid		$HF_{15}O_2$ + $^{13}C_8$	8.184	422.07	421.1	83	376	5	

Abbr.	Compound Name	CAS #	Formula	Retention time (min)	Mol. Wt.	Precursor ion [M-H/D]-	Fragmentor (volts)	Product ions (m/z)	Collision energy (volts)	Structure
M7PFUnDA (IS)	Perfluoro-n-[1,2,3,4,5,6,7-$^{13}C_7$]undecanoic acid		$C_4HF_{21}O_2$ + $^{13}C_7$	11.724	571.09	570.0	97	525	9	
M3PFHxS (IS)	Perfluoro-1-[1,2,3-$^{13}C_3$]hexanesulfonic acid		$C_3HF_{13}SO_3$ + $^{13}C_3$	6.883	403.11	402.0	184	80	45	
M8PFOS (IS)	Perfluoro-[$^{13}C_8$]octanesulfonic acid		$HF_{17}SO_3$ + $^{13}C_8$	9.637	508.13	507.0	203	79.9	97	
M4-6:2 diPAP (IS)	Bis(1H,1H,2H,2H-[1,2-$^{13}C_2$]perfluorooctyl)phosphate		$C_{12}H_9F_{26}O_4P$ + $^{13}C_4$	5.288	794.17	793.0	137	445.0	21	

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164 Table S6: List of targeted PFAS measured by GC-MS.
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Abbr.	Compound Name	CAS #	Formula	Mol. Wt.	Retention time (min)	Quantifier	Qualifier	Structure
4:2 FTOH	2-Perfluorobutyl ethanol (4:2)	2043-47-2	$C_6H_5F_9O$	264.09	5.840	265	227	$F_3C(CF_2)_3(CH_2)_2OH$
6:2 FTOH	2-Perfluorohexyl ethanol (6:2)	647-42-7	$C_8H_5F_{13}O$	364.10	7.569	365	327	$F_3C(CF_2)_5(CH_2)_2OH$
8:2 FTOH	2-Perfluorooctyl ethanol (8:2)	678-39-7	$C_{10}H_5F_{17}O$	464.12	9.993	465	427	$F_3C(CF_2)_7(CH_2)_2OH$
10:2 FTOH	2-Perfluorodecyl ethanol (10:2)	865-86-1	$C_{12}H_5F_{21}O$	564.13	12.460	565	527	$F_3C(CF_2)_9(CH_2)_2OH$
6:2 FTAc	1H,1H,2H,2H-perfluorooctyl acrylate	17527-29-6	$C_{11}H_7F_{13}O_2$	418.15	6.450	419	399	$F_3C(CF_2)_5(CH_2)_2COOCH=CH_2$
8:2 FTAc	1H,1H,2H,2H-Perfluorodecyl acrylate	27905-45-9	$C_{13}H_7F_{17}O_2$	518.17	9.100	519	499	$F_3C(CF_2)_7(CH_2)_2COOCH=CH_2$
10:2FTAc	1H,1H,2H,2H-Perfluorododecyl acrylate	17741-60-5	$C_{15}H_7F_{21}O_2$	618.18	11.916	619	599	$F_3C(CF_2)_9(CH_2)_2COOCH=CH_2$
6:2 FTMAc	1H,1H,2H,2H-perfluorooctyl methacrylate	2144-53-8	$C_{12}H_9F_{13}O_2$	432.18	7.672	433	413	$F_3C(CF_2)_5(CH_2)_2COOC(=CH_2)CH_3$
8:2 FTMAc	1H,1H,2H,2H-heptadecafluorodecyl methacrylate	1996-88-9	$C_{14}H_9F_{17}O_2$	532.19	10.413	533	513	$F_3C(CF_2)_7(CH_2)_2COOC(=CH_2)CH_3$
MeFOSE	2-(N-methylperfluoro-1-octanesulfonamido)-ethanol	24448-09-7	$C_{11}H_8F_{17}NO_3S$	557.22	19.068	558	540	$F_3C(CF_2)_7SO_2N(-CH_3)(CH_2)_2OH$
EtFOSE	2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol	1691-99-2	$C_{12}H_{10}F_{17}NO_3$	539.19	19.194	572	554	$F_3C(CF_2)_7SO_2N(-C_2H_5)(CH_2)_2OH$
M4-4:2 FTOH (SS)	2-Perfluorobutyl-[1,1,2,2-$^2H_4$]-ethanol(4:2)		$C_6HF_9O + D_4$	268.09	5.776	269	230	
M2-8:2 FTOH (SS)	2-Perfluorooctyl-[1,2-$^{13}C_2$]-ethanol(8:2)		$C_8H_5F_{17}O + {}^{13}C_2$	466.12	9.985	467	429	
dMeFOSE (SS)	2-(N-methyl-d_3-perfluoro-1-octanesulfonamido)ethan-d_4-ol		$C_{11}H_1F_{17}NO_3S + D_7$	564.22	19.028	565	547	
M4-8:2 FTOH (IS)	2-Perfluorooctyl-[1,1-$^2H_2$]-[1,2-$^{13}C_2$]-ethanol(8:2)		$C_8H_3F_{17}O + {}^{13}C_2D_2$	468.12	9.946	469	431	

167 Table S7: Surrogate (SS) and internal (IS) standards used to calculate PFAS concentrations.

Native PFASs	SS for correction	IS for quantitation	Surrogate standards	IS for quantitation
PFPrA	M3PFBA	MPFBA	M3PFBA	MPFBA
PFBA	M3PFBA	MPFBA	MPFHxA	M8PFOA
PFPeA	M3PFBA	MPFBA	MPFOA	M8PFOA
PFHxA	MPFHxA	M8PFOA	MPFUnDA	M7PFUnDA
PFHpA	MPFHxA	M8PFOA	M2PFTeDA	M7PFUnDA
PFOA	MPFOA	M8PFOA	M3PFBS	M3PFHxS
PFNA	MPFOA	M8PFOA	MPFHxS	M3PFHxS
PFDA	MPFUnDA	M7PFUnDA	MPFOS	M8PFOS
PFUnDA	MPFUnDA	M7PFUnDA	M2-8:2 FTCA	M8PFOA
PFDoDA	M2PFTeDA	M7PFUnDA	M2-8:2 FTSA	M8PFOS
PFTrDA	M2PFTeDA	M7PFUnDA	dMeFOSA	M8PFOS
PFTeDA	M2PFTeDA	M7PFUnDA	M4-4:2 FTOH	M4-8:2 FTOH
PFHxDA	M2PFTeDA	M7PFUnDA	M2-8:2 FTOH	M4-8:2 FTOH
PFPrS	M3PFBS	M3PFHxS	dMeFOSE	M4-8:2 FTOH
PFBS	M3PFBS	M3PFHxS	M2-8:2 PAP	M4-6:2 diPAP
PFPeS	MPFHxS	M3PFHxS		
PFHxS	MPFHxS	M3PFHxS		
PFHpS	MPFOS	M3PFHxS		
PFOS	MPFOS	M8PFOS		
PFNS	MPFOS	M8PFOS		
PFDS	MPFOS	M8PFOS		
PFECHS	MPFOS	M8PFOS		
Cl-PFOS	MPFOS	M8PFOS		
6:2 Cl-PFESA	MPFHxS	M8PFOS		
8:2 Cl-PFESA	MPFOS	M8PFOS		
4:2 FTSA	M2-8:2 FTSA	M3PFHxS		
6:2 FTSA	M2-8:2 FTSA	M3PFHxS		
8:2 FTSA	M2-8:2 FTSA	M8PFOS		
6:2 FTCA	M2-8:2 FTCA	M8PFOA		
8:2 FTCA	M2-8:2 FTCA	M8PFOA		
10:2 FTCA	M2-8:2 FTCA	M8PFOA		
FBSA	M3PFBS	M3PFHxS		
FHxSA	MPFHxS	M3PFHxS		
FOSA	MPFOS	M8PFOS		
MeFOSA	dMeFOSA	M8PFOS		
EtFOSA	dMeFOSA	M8PFOS		
4:2 FTOH	M4-4:2 FTOH	M4-8:2 FTOH		
6:2 FTOH	M2-8:2 FTOH	M4-8:2 FTOH		
8:2 FTOH	M2-8:2 FTOH	M4-8:2 FTOH		
10:2 FTOH	M2-8:2 FTOH	M4-8:2 FTOH		
MeFOSE	dMeFOSE	M4-8:2 FTOH		
EtFOSE	dMeFOSE	M4-8:2 FTOH		
6:2 FTAc	M4-4:2 FTOH	M4-8:2 FTOH		
8:2 FTAc	M2-8:2 FTOH	M4-8:2 FTOH		
10:2 FTAc	M2-8:2 FTOH	M4-8:2 FTOH		
6:2 FTMAc	M2-8:2 FTOH	M4-8:2 FTOH		
8:2 FTMAc	M2-8:2 FTOH	M4-8:2 FTOH		
6:2 PAP	M2-8:2 PAP	M4-6:2 diPAP		
8:2 PAP	M2-8:2 PAP	M4-6:2 diPAP		
6:2 diPAP	M2-8:2 PAP	M4-6:2 diPAP		
6:2/8:2 diPAP	M2-8:2 PAP	M4-6:2 diPAP		
8:2 diPAP	M2-8:2 PAP	M4-6:2 diPAP		

Table S8. Comparison of the minimum, maximum, median, and average μg F/cm^2 value from PIGE analysis of each cosmetic category.

Category	Minimum	Maximum	Median	Average
Lips (Li)	<0.127	33.9	0.495	2.37
Eyes (E)	<0.127	44.0	0.734	5.73
Foundation (F)	<0.127	54.7	1.06	3.50
Mascara (M)	<0.127	1140	0.120	132
Face (Fa)	<0.127	152	0.232	6.22
Concealer (C)	<0.127	25.7	0.113	3.67
Eyebrow (Eb)	<0.127	15.4	0.027	3.11
Miscellaneous (Mi)	<0.127	12.0	0.282	2.38

Figure S2. Distribution of log µg F/cm^2 measured using PIGE for each cosmetic category. Red bars indicate the median log µg F/cm^2 value for that category.

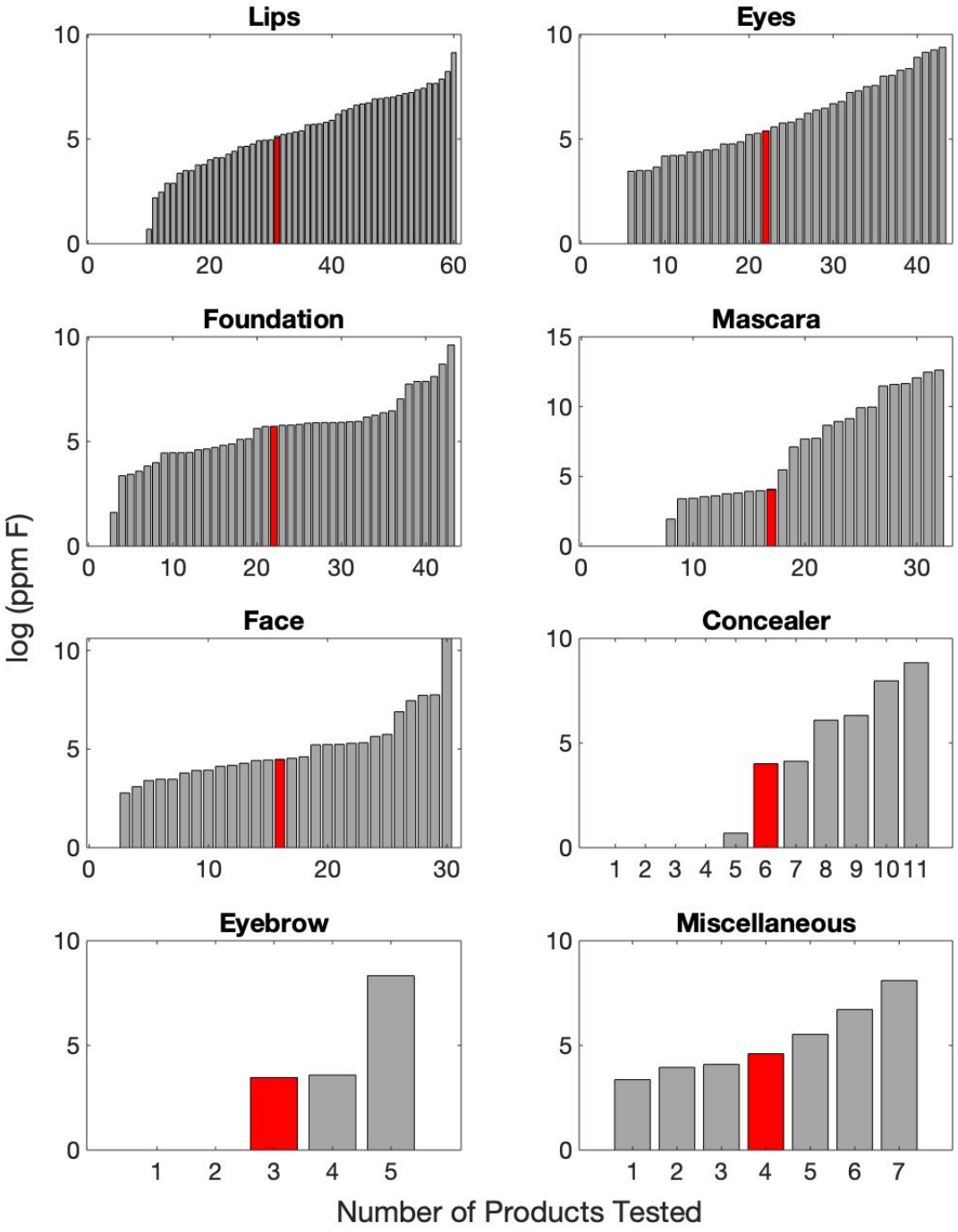

Table S9. Trends in PIGE results for cosmetic subcategories. Lip products can be split into many sub-categories but primarily belong to either solid formulas (lipsticks and balms) or liquid formulas (glosses, stains, and cremes). Roughly 70% (42 of 60) of lip products tested were liquid formulas and of the 29 lip products determined to have high fluorine concentrations, 26 of them were liquid formulas. One sub-category of mascaras is waterproof mascaras. Of the 32 mascaras tested 11 (34%) were waterproof formulas. From the 15 mascaras determined to have high total fluorine concentrations, 60% were waterproof formulas.

Category	All Mascara	Waterproof Mascara	Percent
High Fluorine	15	9	60
Moderate or Low Fluorine	17	2	12
Total	32	11	34

Category	All Lip Products	Liquid Lip Products	Percent
High Fluorine	29	26	90
Moderate or Low Fluorine	31	16	52
Total	60	42	70

Table S10. Comparison of the concentrations in μg F/cm^2 determined from PIGE to the concentrations in μg F/g product. To calculate this, a 1cm x 1cm was chosen to approximate the size of the beam from PIGE. 3 products from each cosmetic product category selected for targeted analysis (lip products, foundations, and mascaras) giving a total of 9 cosmetic products. For all 9 products, five 1 cm by 1 cm Whatman 1 filter paper squares were weighed both before and after the addition of one layer of the cosmetic product. The difference in the before and after weight was used to determine the amount of product applied, which was averaged for each cosmetic product and for all products within the same cosmetic product category. For the 7 products that had quantifiable concentrations of total fluorine the micrograms of F per grams of product were determined using the μg F/cm^2 determined from PIGE, the known 1 cm^2 area, and the calculated average applied mass.

Category	Average applied mass (mg)		Standard deviation of applied mass	Average applied mass (g)
Foundation	3.0		1.5	0.0030
Lipstick	2.5		2.8	0.0025
Mascara	3.7		2.2	0.0037
Product	μg F/cm^2		μg F/g product	
	U.S.	Canadian	U.S.	Canadian
Foundation 1	0.466	0.895	155	298
Foundation 2	5.82	5.87	1940	1960
Foundation 3	4.20	7.07	1400	2360
Lips 1	5.74	9.91	2300	3960
Lips 3	1.72	3.76	688	1500
Mascara 4	2.97	12.7	803	3430
Mascara 5	3.97	9.17	1070	2480

200 Table S11. Full results for all 12 U.S. cosmetic samples selected for targeted analysis using LC-MS/MS and GC-MS. Concentrations
201 of each analyte are given in ng/g (ppb). Cells containing values <MDL are left empty.
202

Class	Analyte	F-1	F-2	F-3	L-1	L-2	L-3	L-4	M-1	M-2	M-3	M-4	M-5
Perfluorinated Alkyl Phosphates	6:2 PAP		23.4	117	130	244	88.2	40.7				116.6	
	8:2 PAP			8.75	43.5	62.0	23.9						
Diester Perfluorinated Alkyl Phosphates	6:2/8:2 diPAP				0.11	0.16	0.12				0.39		
	8:2 diPAP	0.39		0.05	0.16	0.11							
Fluorotelomer Alcohols	4:2 FTOH												65.0
	6:2 FTOH	61.9	10,200	3.55	67.3	306	58.5	84.4	618	207	213	68.7	38.5
	8:2 FTOH	47.1	46.6		18.4	318	10.7	14.2	47.1	29.4	49.4	25.3	11.7
Fluorotelomer Methacrylates	6:2 FTMAc	27.7	47.7	714	26.6	569	81.5	70.2	208	324	55.2	50.5	82.5
	8:2 FTMAc	2.53		4.00	119	60.0			4.51				
Fluorotelomer Acrylates	6:2 FTAc			7.25	8.43			4.55					16.2
	10:2 FTAc		104										
Fluorotelomer Sulfonates	6:2 FTSA								0.74				
	8:2 FTSA		0.05	0.03									
Sulfonamide derivatives	FOSA	0.05				0.09							
	EtFOSA							0.18					
Carboxylic Acids	PFPrA								8.32			2.28	
	PFBA							2.15					
	PFPeA	7.07		4.51					7.06	7.17			
	PFHxA			0.10									
	PFHpA				0.97		0.14						
	PFDA			0.39									
	PFHxDA	0.21			30.4				0.20			0.350	1.24
Sulfonic Acids	PFHxS				0.39								
	PFNS				0.06								

203

204 Table S12. Full results for all 17 Canadian cosmetic samples selected for targeted analysis using LC-MS/MS and GC-MS.
205 Concentrations of each analyte are given in ng/g (ppb). Cells containing values <MDL are left empty. Samples highlighted in orange
206 do not have a replicate U.S. product.

Class	Analyte	F-1	F-2	F-3	F-4	L-1	L-2	L-3	L-4	L-5	L-6	M-8	M-2	M-3	M-4	M-5	M-6	M-7
Perfluorinated Alkyl Phosphates	6:2 PAP		1.5	2.0	3.1	18.2	17.8	11.4					9.0	12.3	12.0	4.1	10.9	9.0
Diester Perfluorinated Alkyl Phosphates	6:2/8:2 diPAP	0.4		0.6														
Fluorotelomer Alcohols	6:2 FTOH	40.9	19.4	634	263	34.7		1,340	499	89.9	841	4.6	16.3	22.9	7.5	77.1	165	22.1
	8:2 FTOH			955	484		691	893			1,510							
	10:2 FTOH	3.5	3.6	121	59.9		87.4	80.6		27.7	259					12.6	34.6	7.3
Fluorotelomer Methacrylates	6:2 FTMAc		24.7	180	174	96.8	176	1,440	920	34.6	239			88.7	12.1	26.7	148	2.9
Fluorotelomer Acrylates	6:2 FTAc								49.7		188							
Sulfonamide derivatives	FBSA		0.2						40.9			0.8						0.7
	FOSA	2.3			5.5		18.2	19.5						14.3		4.6		
Chlorinated Sulfonic Acids	Cl-PFOS								10.9									
	6:2 Cl-PFESA												52.3					18.6
	8:2 Cl-PFESA	6.0	3.8		3.1	38.2						8.8						
Carboxylic Acids	PFPeA		1.7				12.8	16.5		13.1	14.0				28.6			
	PFDA	6.3	3.6			21.1	28.5							25.0				
	PFUnDA																	18.3
	PFDoDA		5.5	3.1			15.8	8.0							14.5	4.7		
	PFTrDA								53.6									
	PFHxDA	5.9	4.0	4.8			9.6			10.3	17.2			8.5		10		
Sulfonic Acids	PFPeS	0.5	1.9	2.2		6.0	27.6	2.7	25.5	25.6	7.3	2.8	13.2	4.1	11.0	7.5		3.5
	PFHxS	4.0	6.5	7.6	1.2		12.4	11.7	6.4	33.5	12.5	9.3	6.7	16.4	9.6	13.7	6.6	5.3
	PFHpS				6.9		11.4											
	PFOS			15.5								6.6						

Table S13. Detection frequency of PFAS classes and analytes detected in 12 U.S. and 17 Canadian products selected cosmetic products from targeted analysis. All other analytes were not measured above their MDL. Values are rounded to the nearest whole percent.

Class	Analyte	U.S. DF (%)	Canadian DF (%)
Perfluorinated Alkyl Phosphates	6:2 PAP	58	71
	8:2 PAP	33	-
Diester Perfluorinated Alkyl Phosphates	6:2/8:2 diPAP	33	12
	8:2 diPAP	33	-
Fluorotelomer Alcohols	4:2 FTOH	8	-
	6:2 FTOH	100	94
	8:2 FTOH	92	29
	10:2 FTOH	-	65
Fluorotelomer Methacrylates	6:2 FTMAc	100	82
	8:2 FTMAc	42	-
Fluorotelomer Acrylates	6:2 FTAc	33	12
	10:2 FTAc	8	-
Fluorotelomer Sulfonates	6:2 FTSA	8	-
	8:2 FTSA	17	-
Sulfonamide derivatives	FOSA	17	35
	EtFOSA	8	-
	FBSA	-	24
Chlorinated Sulfonic Acids	Cl-PFOS	-	6
	6:2 Cl-PFESA	-	12
	8:2 Cl-PFESA	-	29
Carboxylic Acids	PFPrA	17	-
	PFBA	8	-
	PFPeA	33	35
	PFHxA	8	-
	PFHpA	17	-
	PFDA	8	29
	PFHxDA	42	47
	PFUnDA	-	6
	PFDoDA	-	35
	PFTrDA	-	6
Sulfonic Acids	PFHxS	8	94
	PFNS	8	-
	PFPeS	-	88
	PFHpS	-	12
	PFOS	-	12

Table S14. List of ingredients and their described use in cosmetics that were reported at least two times on the ingredient lists of U.S. products selected for targeted analysis. Ingredient names highlighted green are those that are possible or likely a source of inorganic F. Ingredient names highlighted yellow are those where industrial reports, brochures, or patents (references given) describe the use of organic F (PFAS) as a treatment or that the listed ingredient has a fluorinated alternative.

Listed Name	Additional Name(s)	Described Use	Reference
Acrylates Copolymer		Viscosity controller	8, 9
Alcohol		Antimicrobial/antibacterial, solvent	
Aluminum Hydroxide		Emollient, humectant, viscosity controller	
Aminomethyl Propanediol		Buffering agent	
Ascorbyl Palmitate	Vitamin C	Antioxidant	
BHT	Butylated Hydroxytoluene	Preservative	
Butylene Glycol		Moisturizer/humectant, solvent, viscosity controller	
C12-15 Alkyl Benzoate		Emollient, antimicrobial/antibacterial	
Calcium Sodium Borosilicate		Bulking agent	
Caprylyl Glycol		Moisturizer/humectant, emollient	
Cera Alba	Beeswax	Emollient, viscosity controller	
Cera Carnauba	Vegetable Wax	Emollient and stabilizer	
CI 15850		Colorant	
CI 15985	Yellow No. 6	Colorant	
CI 19140	Tartrazine	Colorant	
CI 42090	Blue 1	Colorant	10
CI 45410	Red 28	Colorant	
CI 75470	Carmine	Colorant	

CI 77007	Ultramarines	Colorant	10
CI 77288	Chromium Oxide Greens	Colorant	
CI 77491	Red Iron Oxide	Pigment	10
CI 77492	Yellow Iron Oxide	Pigment	10
CI 77499	Black Iron Oxide	Pigment	10
CI 77510	Iron Blue	Colorant	
CI 77742	Manganese Violet	Colorant	
CI 77891	Titanium Dioxide	Pigment	10
Copernicia Cerifera	Vegetable Wax	Emollient and stabilizer	
Cyclopentasiloxane		Emollient	
Dimethicone		Viscosity controller, emulsion stabilizer	11-13
Disodium Stearoyl Glutamate		Surfactant/cleanser	
Disteardimonium Hectorite		Viscosity controller, emulsion stabilizer,	
Hexadecene Copolymer		Viscosity controller, film-former	
Isododecane		Emollient	
Magnesium Sulfate		Viscosity controller, emulsion stabilizer	
Methicone		Emollient	11-13
Mica		Colorant, bulking agent, sheen/shimmer	10, 14, 15
Nylon-12		Viscosity controller, texture enhancer	10, 16
Oryza Sativa Cera/Rice Bran Wax	Rice	Bulking agent, conditioner	
Palmitic Acid		Emollient, emulsifier	
Panthenol	pro-Vitamin B5	Soothing, moisturizer/humectant	
Paraffin		Viscosity controller, perfumer	
PEG-10 Dimethicone		Emulsifier	11-13
Pentaerythrityl Hydrogenated Rosinate		Film-former	

Pentylene Glycol		Solvent, moisturizer/humectant	
Phenoxyethanol		Preservative	
Polybutene		Viscosity controller	
Polyethylene		Viscosity controller	
Polymethylsilsesquioxane		Texture enhancer	16
Propylene Carbonate		Solvent, viscosity controller	
Quaternium-90 Bentonite		Viscosity controller	
Silica		Viscosity controller, absorbent/mattifier	10, 16
Silica Silylate		Viscosity	10, 16
Sorbic Acid		Preservative	
Stearic Acid		Viscosity controller, emollient	
Synthetic Fluorphlogopite	Synthetic mica	Bulking agent, viscosity controller	
Talc		Bulking agent, absorbent/mattifier	10, 14, 15
Tocopherol	Vitamin E	Antioxidant	
Tocopheryl Acetate	Acetate form of Vitamin E	Antioxidant	
Triethyl Citrate		Perfumer	
Trimethylsiloxysilicate		Emollient	17
VP/Eicosene Copolymer		Viscosity controller	
Water		N/A	

Table S15. List of ingredients cosmetics that were reported just once on the ingredient lists of U.S. products selected for targeted analysis.

Listed Name		
Bis-PEG/PPG-14/14 Dimethicone	CI 17200	Isobutane
Dimethicone Copolymer	CI 45380	Isohexadecane
Dimethicone Crosspolymer	CI 77163	Isononyl Isononanoate
Dimethicone/PEG-10/15 Crosspolymer	CI 77289	Isopentyldiol
Dimethicone/Vinyl Dimethicone Crosspolymer	Acacia Senegal Gum	Laureth-7
Lauryl PEG-10 Tris(Trimethylsiloxy)Silylethyl Dimethicone	Aloe Barbadensis Leaf Extract	Lauroyl Lysine
PEG-9 Polydimethylsiloxyethyl Dimethicone	Alumina	Lecithin
Vinyl Dimethicone/Methicone Silsesquioxane Crosspolymer	Aluminum Starch Octenylsuccinate	Limonene
Diphenylsiloxy Phenyl Trimethicone	Argania Spinosa Kernel Oil	Magnesium Gluconate
Phenyl Trimethicone	Benzyl Alcohol	Magnesium Silicate
PVP/Eicosene Copolymer	Benzyl Benzoate	Maris Sal/Sea Salt
Triacontanyl Pvp	Butylene Glycol Dicaprylate/Dicaprate	Methylparaben
VP/VA Copolymer	Calcium Aluminum Borosilicate	Octyldodecanol
Ethylene/VA Copolymer	Calcium Gluconate	Pentaerythrityl Tetra-Di-T-Butyl Hydroxyhydrocinnamate
Allyl Stearate/VA Copolymer	Camellia Sinensis Leaf Extract	Perlite
Acrylates/Polytrimethylsiloxymethacrylate Copolymer	Candelilla Cera/Euphorbia Cerifera (Candelilla) Wax/Cire De Candelilla	Phytosteryl Macadamiate

Acrylonitrile/Methyl Methacrylate/Vinylidene Chloride Copolymer	Caprylic/Capric Triglyceride	Plukenetia Volubilis Seed Oil
Ethylenediamine/Stearyl Dimer Dilinoleate Copolymer	Carthamus Tinctorius Seed Oil/Safflower Seed Oil	Propyl Gallate
Hdi/Trimethylol Hexyllactone Crosspolymer	Chlorphenesin	Propylene Glycol
Hydrogenated Polycyclopentadiene	Citric Acid	Propylparaben
Methyl Methacrylate Crosspolymer	Citronellol	Pullulan
PEG-30 Glyceryl Stearate	Cucumis Sativus (Cucumber) Fruit Extract	Rosa Canina Fruit Oil
Polybutylene Terephthalate	Disodium Edta	Sclerotium Gum
Polyethylene Terephthalate	Ethylene Brassylate	Sodium Ascorbyl Phosphate
Polyglyceryl-3 Diisostearate	Ethylhexylglycerin	Sodium Benzoate
Polyglyceryl-6 Polyricinoleate	Euphorbia Cerifera (Candelilla) Wax	Sodium Carrageenan
Polypropylsilsesquioxane	Fragrance (Parfum)	Sorbitan Isostearate
Polyquaternium -10	Glycerin	Steareth-2
Polyquaternium-7	Glyceryl Stearate	Steareth-21
Polysilicone-11	Glycine Soja (Soybean) Oil	Sucrose Acetate Isobutyrate
Polyvinyl Alcohol	Hoya Lacunosa Flower Extract	Tetrasodium Edta
Polyvinyl Laurate	Hydrogenated Castor Oil Isostearate	Tin Oxide
Trimethylpentanediol/Adipic Acid/Glycerin Crosspolymer	Hydrogenated Jojoba Oil	Triethanolamine
C30-45 Alkyldimethylsilyl Polypropylsilsesquioxane	Hydrogenated Olive Oil Stearyl Esters	Triethoxycaprylylsilane
	Hydroxyethylcellulose	Xanthan Gum

Table S16. Heatmap relating all ingredients listed in the U.S. products selected for targeted analysis to the number of times the ingredient was found in each category of F concentrations identified by PIGE. The number of maximum times an ingredient could be given in each category were 4, 1, and 7 times each for Low F, Moderate F, and High F respectively.

Ingredient Name	Low F	Moderate F	High F
Dimethicone	2	1	3
PEG-10 Dimethicone	0	0	2
Methicone	0	1	1
VP/Eicosene Copolymer	1	0	3
Acrylates Copolymer	2	0	0
Cyclopentasiloxane	1	1	4
Hexadecene Copolymer	1	0	1
Polymethylsilsesquioxane	0	1	1
Trimethylsiloxysilicate	2	1	3
Disteardimonium Hectorite	0	1	6
Mica	1	1	3
Silica	2	1	4
Silica Silylate	3	0	1
Synthetic Fluorphlogopite	1	0	3
Talc	0	0	2
CI 15850	2	0	2
CI 15985	1	0	1
CI 19140	3	0	2
CI 42090	3	0	1
CI 45410	2	0	1
CI 75470	0	0	2

CI 77007	1	0	1
CI 77288	1	0	1
CI 77491	3	1	5
CI 77492	3	1	5
CI 77499	4	1	7
CI 77510	1	0	1
CI 77742	1	0	1
CI 77891	3	1	5
Alcohol	1	0	2
Aluminum Hydroxide	1	0	1
Aminomethyl Propanediol	2	0	0
Ascorbyl Palmitate	2	0	0
BHT	1	0	2
Butylene Glycol	1	1	1
C12-15 Alkyl Benzoate	0	0	2
Calcium Sodium Borosilicate	1	0	1
Caprylyl Glycol	2	1	2
Cera Alba	2	0	3
Cera Carnauba	1	0	1
Copernicia Cerifera	1	0	3
Disodium Stearoyl Glutamate	1	0	1
Isododecane	2	0	6
Magnesium Sulfate	0	1	2
Nylon-12	2	0	1
Oryza Sativa Cera/Rice Bran Wax	1	0	1
Palmitic Acid	2	0	0
Panthenol	2	0	0

Paraffin	2	0	2
Pentaerythrityl Hydrogenated Rosinate	0	0	2
Pentylene Glycol	0	0	2
Phenoxyethanol	4	1	5
Polybutene	2	0	2
Polyethylene	1	0	2
Propylene Carbonate	1	0	3
Quaternium-90 Bentonite	1	0	1
Sorbic Acid	0	0	2
Stearic Acid	2	0	0
Tocopherol	1	1	2
Tocopheryl Acetate	2	1	1
Triethyl Citrate	1	1	0
Water	2	1	5
Bis-PEG/PPG-14/14 Dimethicone	0	0	1
Dimethicone Copolymer	1	0	0
Dimethicone Crosspolymer	1	0	0
Dimethicone/PEG-10/15 Crosspolymer	0	1	0
Dimethicone/Vinyl Dimethicone Crosspolymer	0	0	1
Lauryl PEG-10 Tris(Trimethylsiloxy)Silylethyl Dimethicone	0	0	1
PEG-9 Polydimethylsiloxyethyl Dimethicone	0	1	0
Vinyl Dimethicone/Methicone Silsesquioxane Crosspolymer	0	0	1
Diphenylsiloxy Phenyl Trimethicone	0	0	1
Phenyl Trimethicone	0	1	0
PVP/Eicosene Copolymer	0	0	1
Triacontanyl PVP	0	0	1
VP/VA Copolymer	1	0	0
Ethylene/VA Copolymer	1	0	0

Allyl Stearate/VA Copolymer	0	0	1
Acrylates/Polytrimethylsiloxymethacrlate Copolymer	0	0	1
Acrylonitrile/Methyl Methacrylate/Vinylidene Chloride Copolymer	0	0	1
Ethylenediamine/Stearyl Dimer Dilinoleate Copolymer	0	0	1
HDI/Trimethylol Hexyllactone Crosspolymer	0	1	0
Hydrogenated Polycyclopentadiene	0	0	1
Methyl Methacrylate Crosspolymer	0	0	1
Peg-30 Glyceryl Stearate	0	0	1
Polybutylene Terephthalate	1	0	0
Polyethylene Terephthalate	1	0	0
Polyglyceryl-3 Diisostearate	0	1	0
Polyglyceryl-6 Polyricinoleate	1	0	0
Polypropylsilsesquioxane	1	0	0
Polyquaternium -10	0	0	1
Polyquaternium-7	0	0	1
Polysilicone-11	0	1	0
Polyvinyl Alcohol	1	0	0
Polyvinyl Laurate	0	0	1
Trimethylpentanediol/Adipic Acid/Glycerin Crosspolymer	0	0	1
C30-45 Alkyldimethylsilyl Polypropylsilsesquioxane	1	0	0
CI 17200	0	0	1
CI 45380	1	0	0
CI 77163	1	0	0
CI 77289	1	0	0
Acacia Senegal Gum	1	0	0
Aloe Barbadensis Leaf Extract	0	1	0
Alumina	1	0	0
Aluminum Starch Octenylsuccinate	0	1	0

Argania Spinosa Kernel Oil	0	0	1
Benzyl Alcohol	1	0	0
Benzyl Benzoate	1	0	0
Butylene Glycol Dicaprylate/Dicaprate	0	0	1
Calcium Aluminum Borosilicate	1	0	0
Calcium Gluconate	0	0	1
Camellia Sinensis Leaf Extract	0	1	0
Candelilla Cera/Euphorbia Cerifera (Candelilla) Wax/Cire De Candelilla	1	0	0
Caprylic/Capric Triglyceride	0	0	1
Carthamus Tinctorius Seed Oil/Safflower Seed Oil	0	0	1
Chlorphenesin	1	0	0
Citric Acid	0	0	1
Citronellol	1	0	0
Cucumis Sativus (Cucumber) Fruit Extract	0	1	0
Disodium Edta	0	0	1
Ethylene Brassylate	0	1	0
Ethylhexylglycerin	0	0	1
Euphorbia Cerifera (Candelilla) Wax	1	0	0
Fragrance(Parfum)	0	0	1
Glycerin	0	0	1
Glyceryl Stearate	1	0	0
Glycine Soja (Soybean) Oil	0	0	1
Hoya Lacunosa Flower Extract	0	0	1
Hydrogenated Castor Oil Isostearate	0	0	1
Hydrogenated Jojoba Oil	0	0	1
Hydrogenated Olive Oil Stearyl Esters	1	0	0
Hydroxyethylcellulose	1	0	0

Isobutane	0	0	1
Isohexadecane	0	0	1
Isononyl Isononanoate	0	0	1
Isopentyldiol	0	0	1
Laureth-7	0	1	0
Lauroyl Lysine	1	0	0
Lecithin	0	1	0
Limonene	1	0	0
Magnesium Gluconate	0	0	1
Magnesium Silicate	1	0	0
Maris Sal/Sea Salt	0	1	0
Methylparaben	0	0	1
Octyldodecanol	0	0	1
Pentaerythrityl Tetra-Di-T-Butyl Hydroxyhydrocinnamate	0	0	1
Perlite	0	0	1
Phytosteryl Macadamiate	0	0	1
Plukenetia Volubilis Seed Oil	0	0	1
Propyl Gallate	0	0	1
Propylene Glycol	0	0	1
Propylparaben	0	0	1
Pullulan	0	1	0
Rosa Canina Fruit Oil	0	0	1
Sclerotium Gum	0	1	0
Sodium Ascorbyl Phosphate	0	1	0
Sodium Benzoate	0	0	1
Sodium Carrageenan	0	1	0
Sorbitan Isostearate	0	0	1
Steareth-2	1	0	0

Steareth-21	1	0	0
Sucrose Acetate Isobutyrate	1	0	0
Tetrasodium Edta	0	1	0
Tin Oxide	1	0	0
Triethanolamine	1	0	0
Triethoxycaprylylsilane	0	0	1
Xanthan Gum	0	1	0

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