



Life cycle of tattooing pigments in the human body

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The spectrum of body modifications and their perception in society

What is tattooing?

.... a mixture “for tattooing purposes” means injection or introduction of the mixture into a person’s skin, mucous membrane or eyeball, by any process or procedure (including procedures commonly referred to as permanent make-up, cosmetic tattooing, micro-blading and micro-pigmentation), with the aim of making a mark or design on his or her body.



<https://flickr.com/photos/47166475@N05/20017394961>



BfR Datenbank



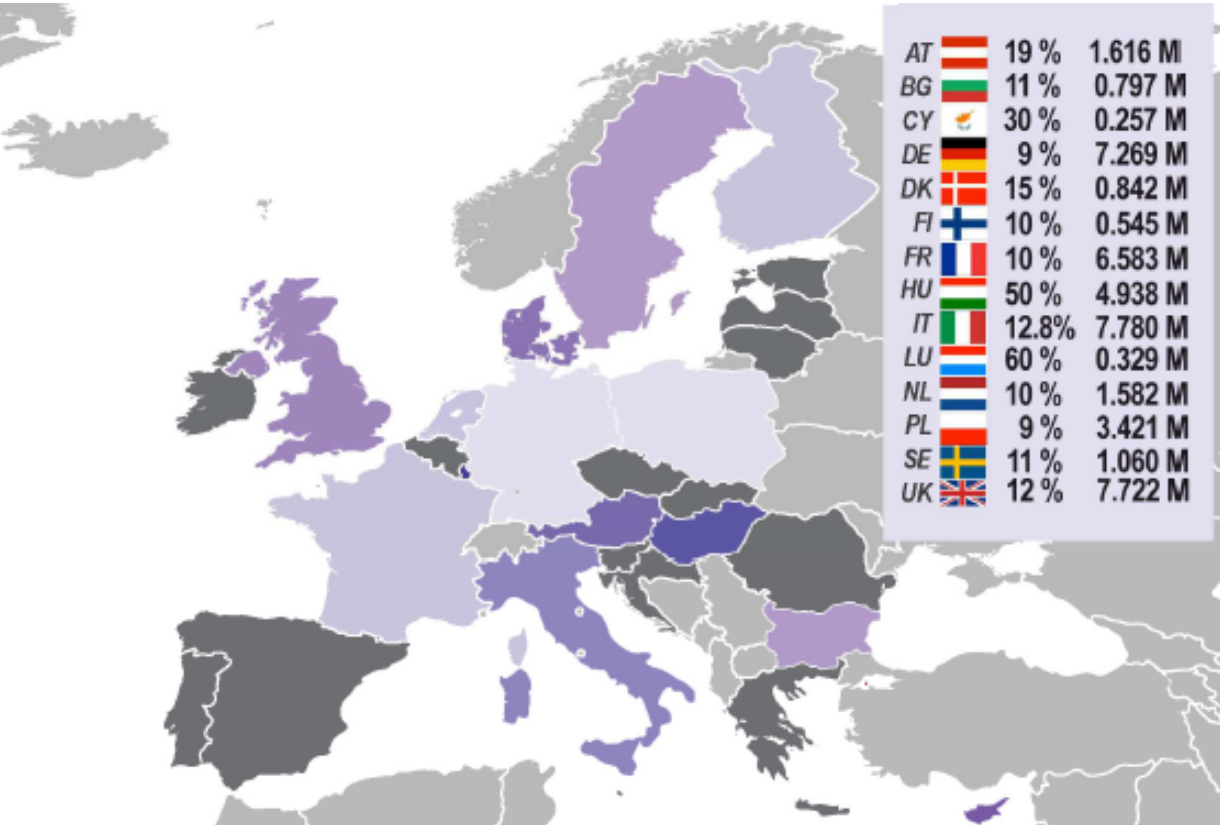
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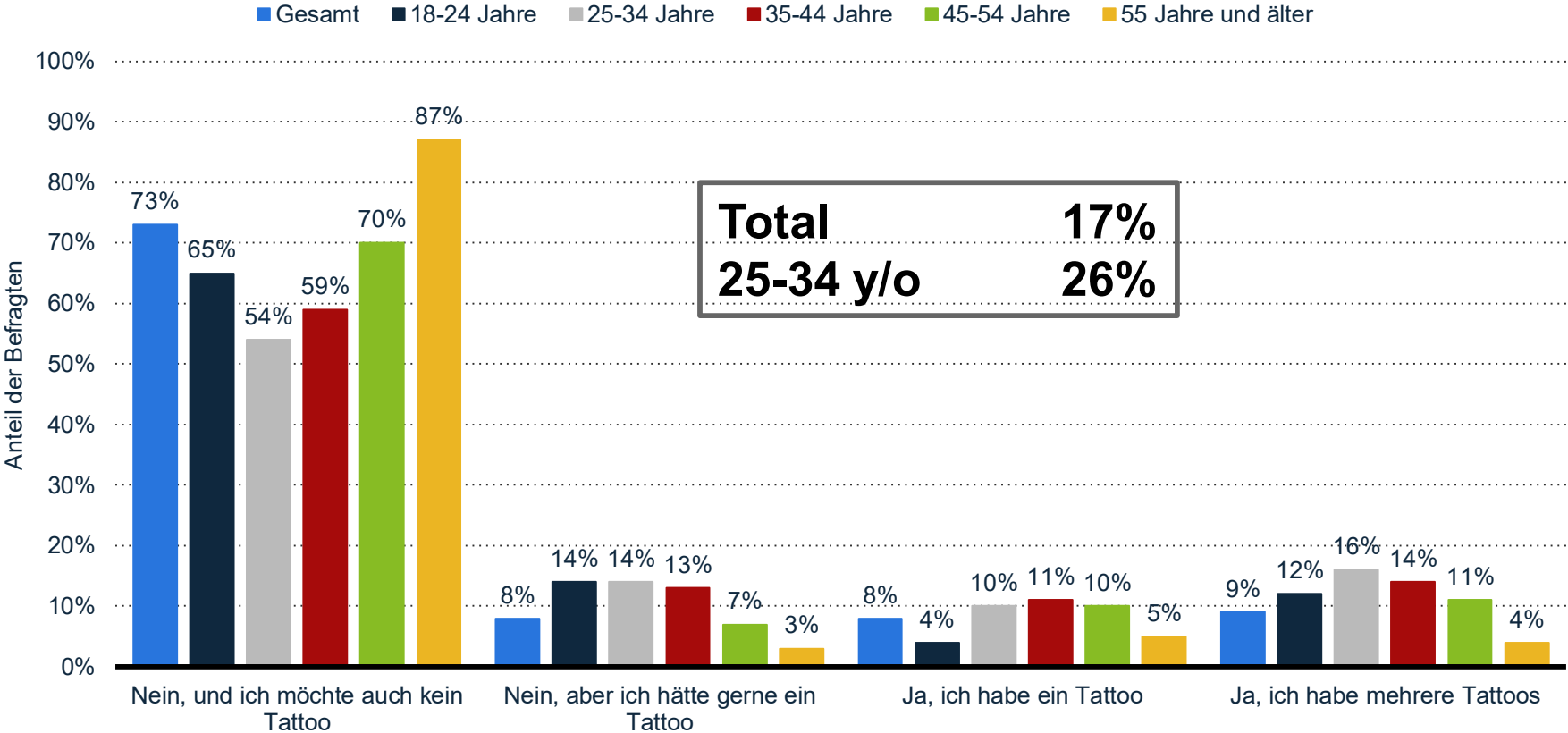
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Are you wearing a tattoo?

JRC 2016



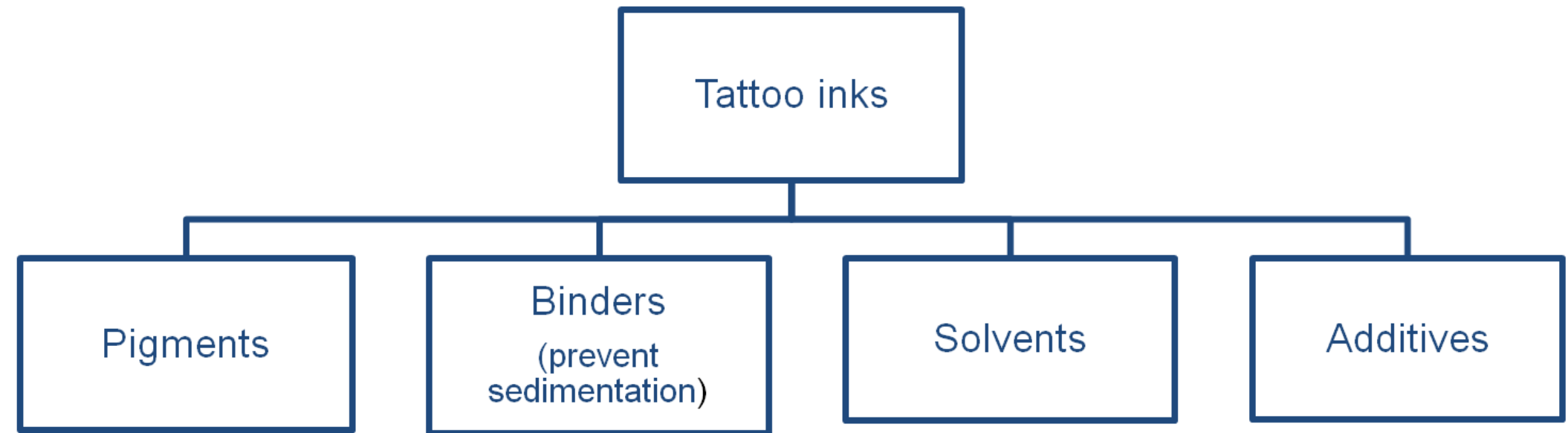
Survey in Germany on tattoos by age group 2021



YouGov; [ID 1253983](#)

<https://de.statista.com/statistik/daten/studie/1253983/umfrage/umfrage-in-deutschland-zu-tattoos-nach-altersgruppen/>

Composition of tattoo inks

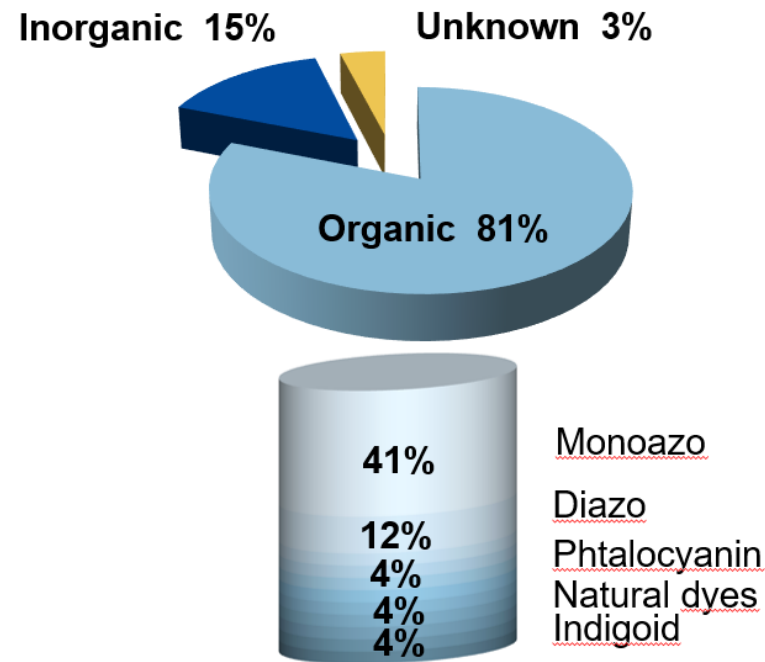


Inorganic pigments: titanium dioxide, iron oxide, chromium oxide, carbon black, barium sulfate (filler)
Organic pigments: e.g. azo pigments, polycyclic aromatic pigments, lake pigments precipitated with e.g., metal salts

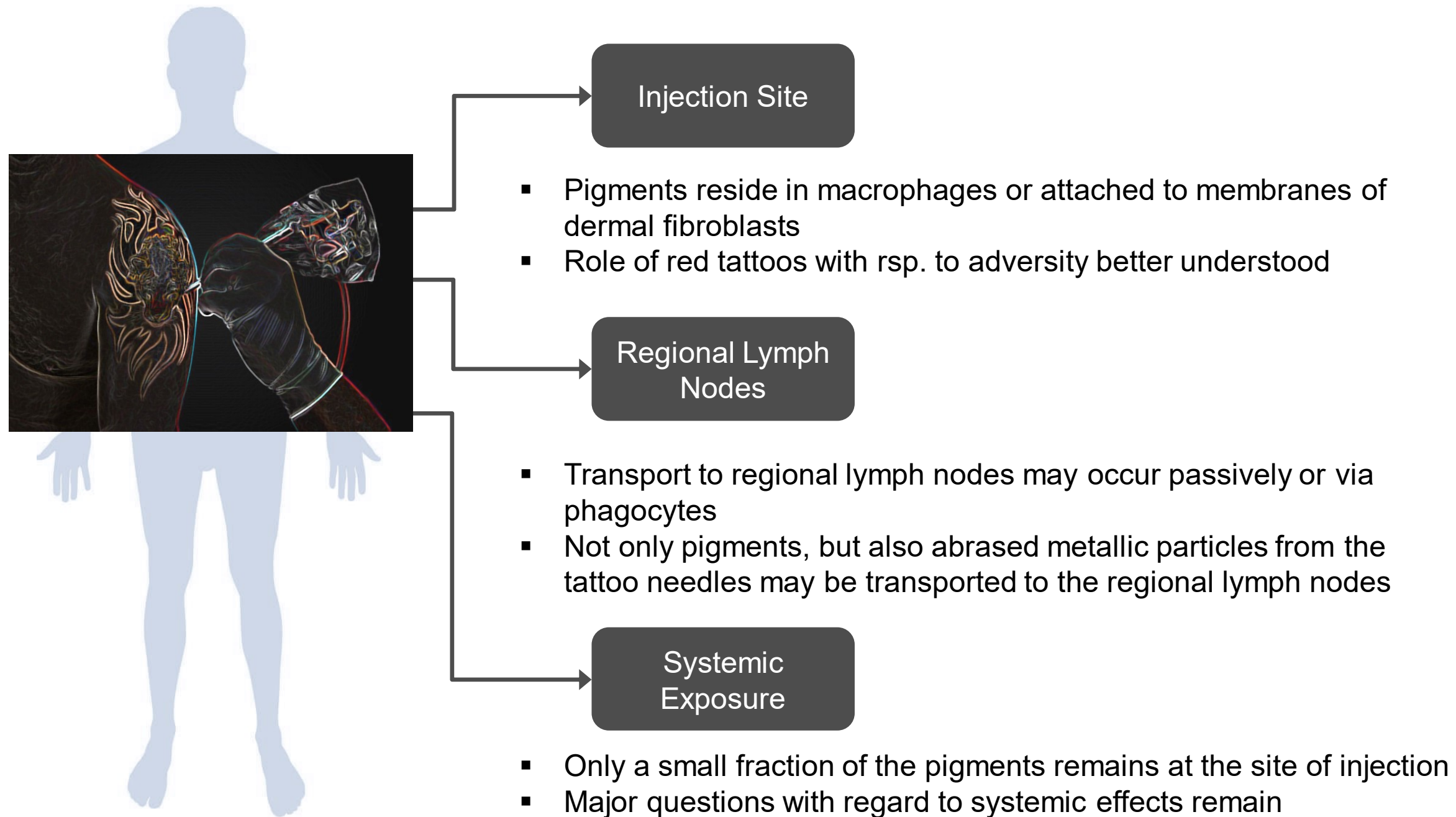
Polyethylene glycol (PEG), polyvinylpyrrolidone (PVP), block copolymers (acrylates, poloxamers), shellac, sugars (traganth, gummi arabicum)

Water, simple alcohols, polyols

Preservatives, thickening agents, surfactants

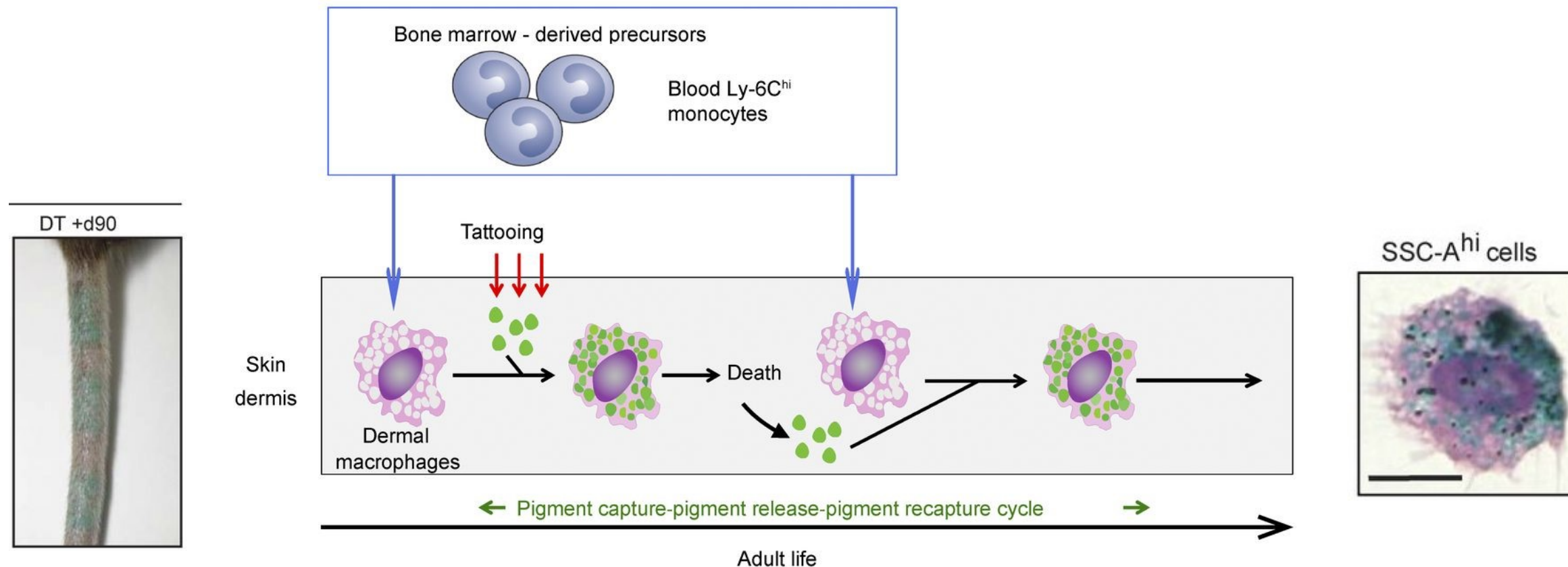


What do we know about the distribution of tattoo pigments in the body?



What happens at the injection site?

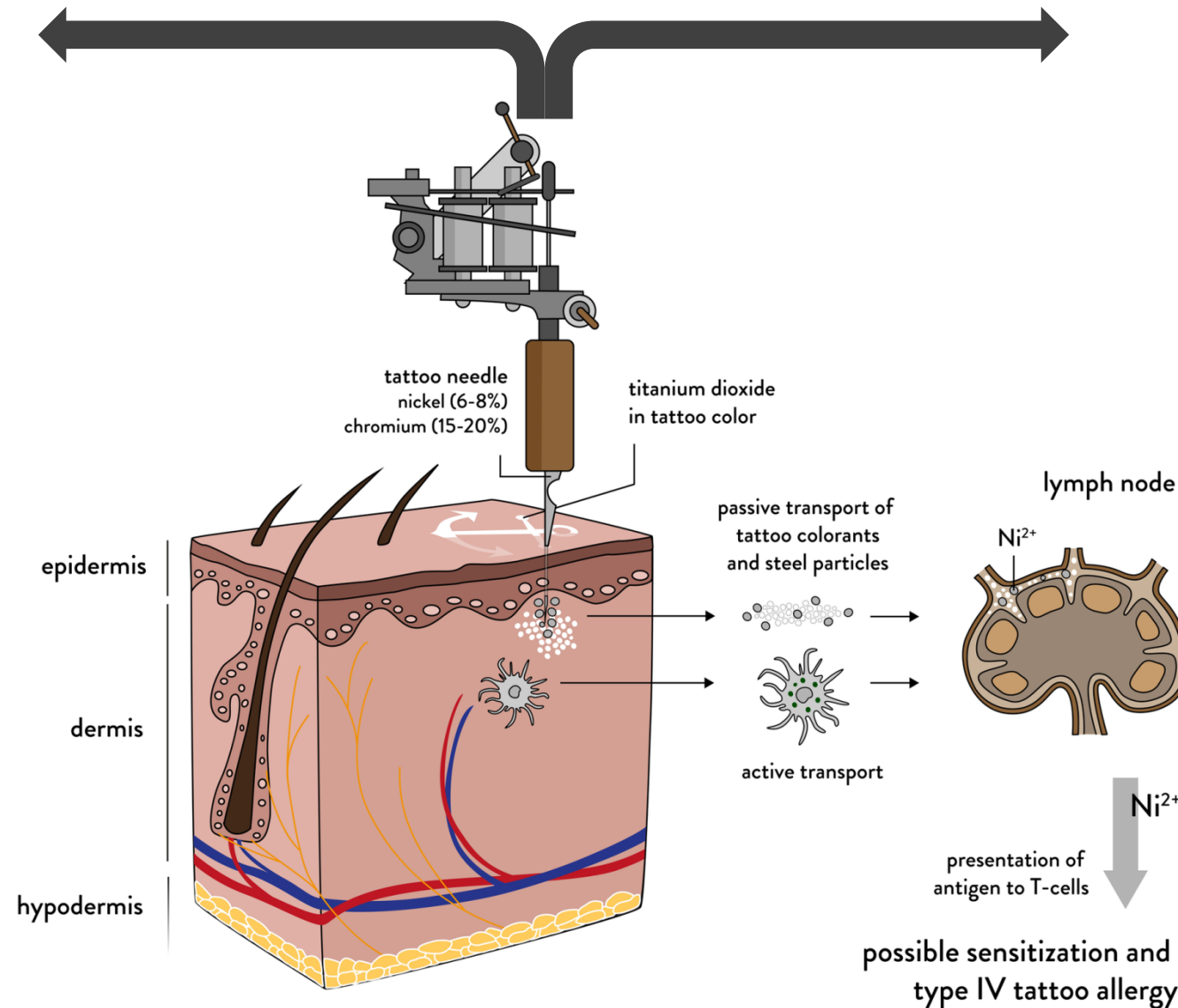
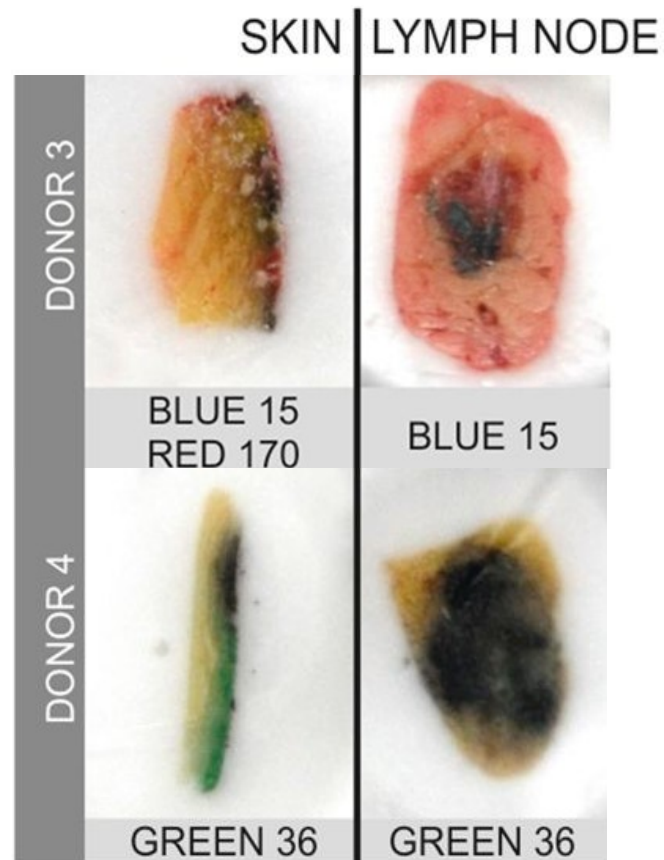
- Pigments injected into the dermis reside in cells and connective tissue.
- Tattoo pigments injected into the mouse tail remained mainly in the dermal resident macrophages after endocytosis.
- Free pigment particles are readily internalised by newly forming macrophages.



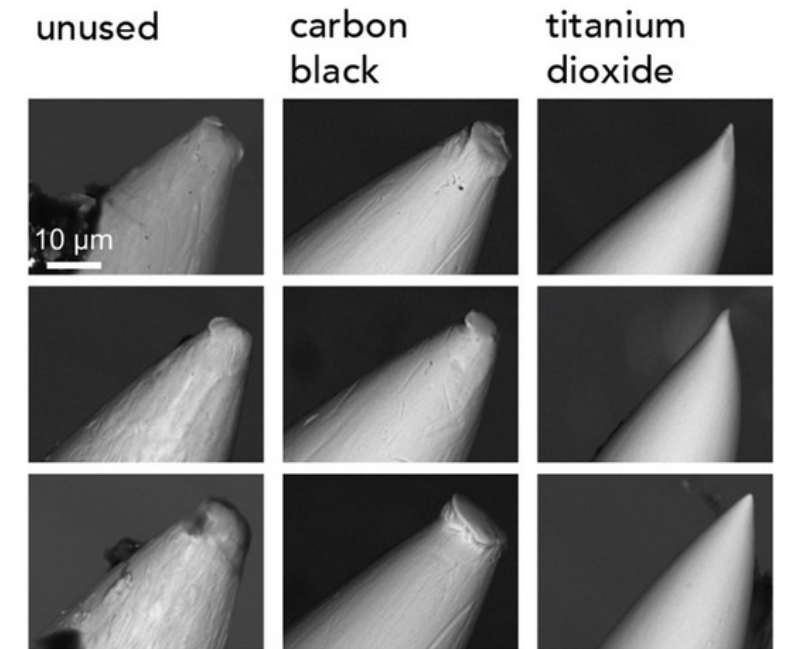
A. Baranska et al., (2018), J Exp Med 215(4):1115–1133

What happens at the regional lymph nodes?

Migration of pigments to the regional lymph nodes



Deposit of tattoo needle abrasion



I. Schreiver et al., Scientific Reports (2017), 7 (1), 11395
 I. Schreiver et al., (2019) Part Fibre Toxicol 16(1):33

What is known about the systemic distribution of tattoo inks?

- Direct contact of tattooing agents with blood and lymph fluids takes place.
- A rapid systemic distribution of the soluble ingredients can be assumed.
- Studies suggest that over 80% of the injected pigments are eliminated.
- In animal studies, pigments could be detected in the liver of mice one year after administration.
- No correlation could be found between tattoos and cancers or other systemic complications.



Lerche et al., (2015) Photoimmunol Photomed 31(5):261–268

Minimum Testing Requirements

Specifications for Ingredients of Tattoo Inks

- Purity
- Stability
- Additional information on pigment particles:
 - i. Number-based particle size distribution
 - ii. Morphology/shape/crystalline structure
 - iii. Surface properties
 - iv. Dispersibility
 - v. Density



Minimum toxicological requirements - *in vitro/in chemico* testing

- Consider compatibility of tests with the physico-chemical properties of pigments
- Test according to OECD Test Guidelines and GLP

Skin irritation & corrosion

Eye irritation & damage

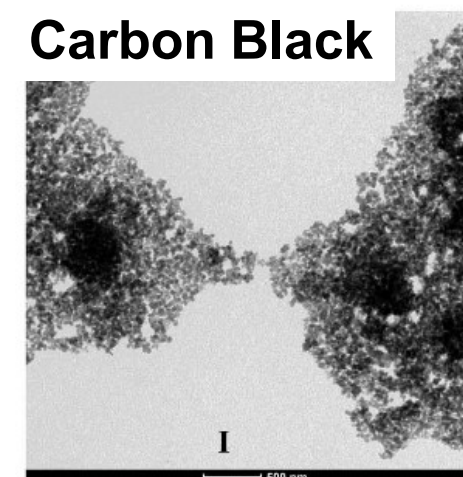
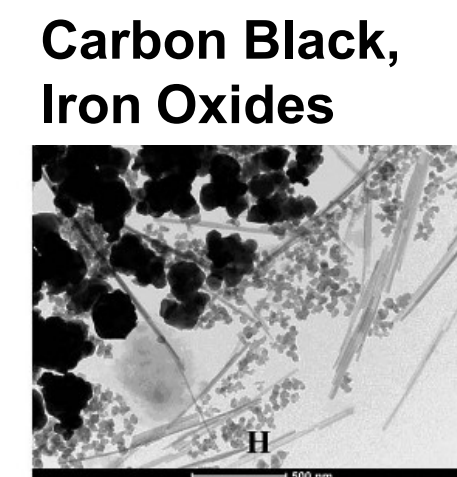
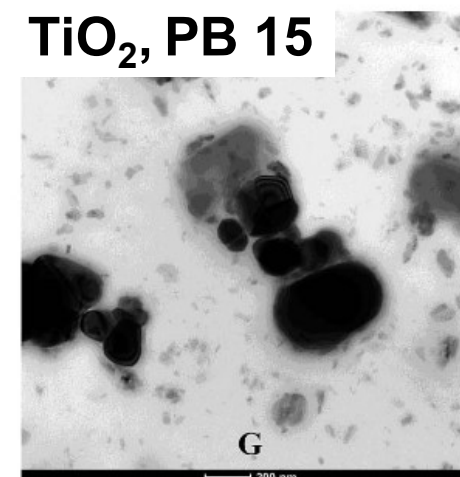
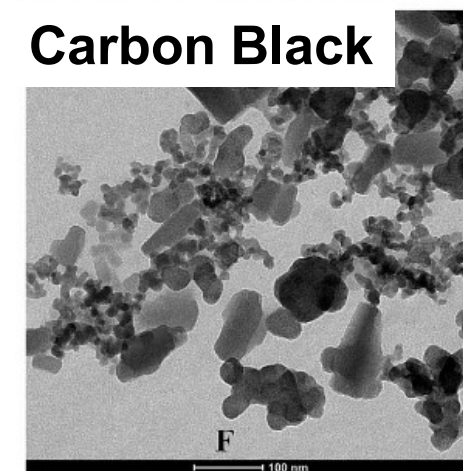
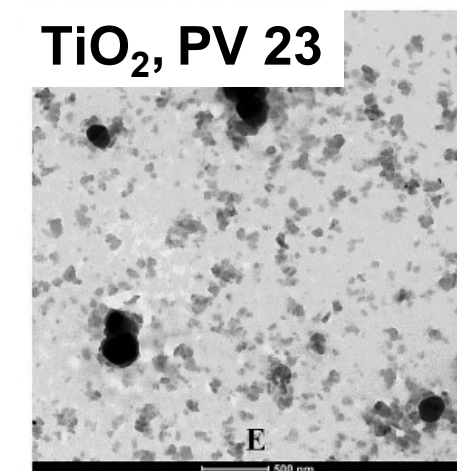
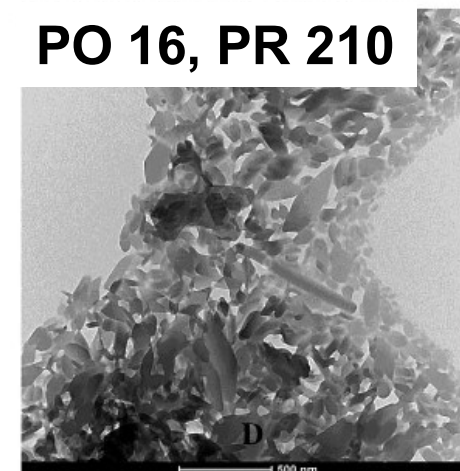
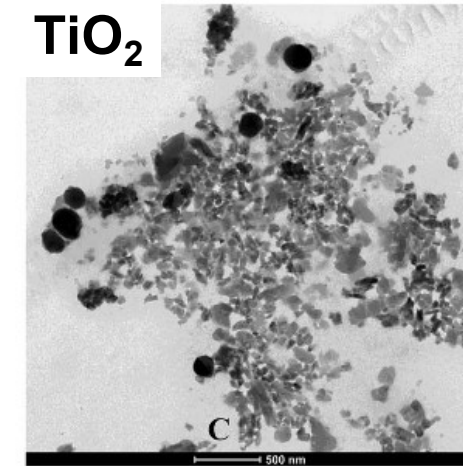
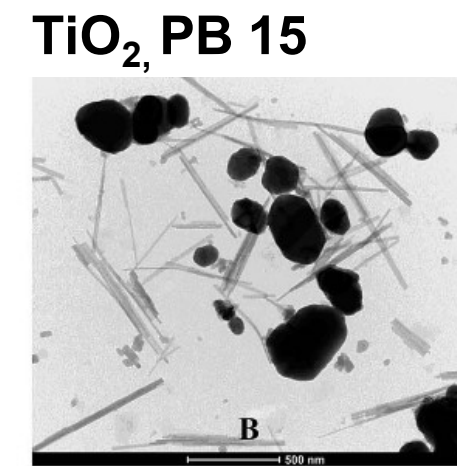
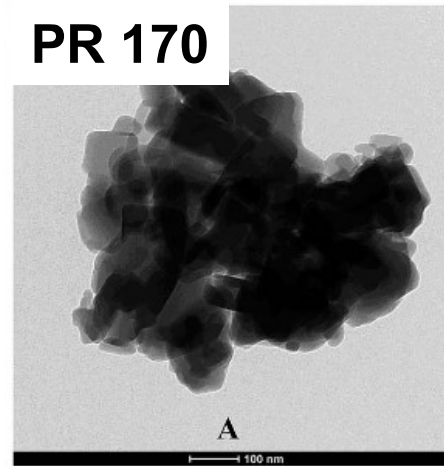
Skin sensitization

Phototoxicity

**Mutagenicity/genotoxicity
*incl. photogenotoxicity***

Tattoo pigments that meet the minimum toxicological requirements reduce possible risks according to the current state of science and technology.

Pigment particles in tattoo inks



Bocca et al (2017) Journal of Analytical Atomic Spectrometry 32(3):616-628
Battistini et al (2020) Chemosphere 245:125667

Asymmetric Flow Field Fractionation (AF4) and Multi-Angle Light Scattering (MALS)-ICP-MS

Ink number (name)	TEM, ^a nm	DLS, ^c nm	AF4-MALS, ^d nm	SP-ICP-MS, ^e nm
2 (Ice blue)	170 ± 64 (127-227)	421 (110-980)	42 (16-65) 269 (60-490)	109 ± 17 (Cu-phthalocyanine) 183 ± 11 (Al ₂ O ₃) 441 ± 161 (TiO ₂)
5 (Deep violet)	39 ± 10 (31-48) ^b	31 (19-52) 137 (60-281)	56 (11-100) 271 (100-490)	427 ± 97 (TiO ₂)
6 (Black outlining)	19 ± 11 (12-29)	152 (49-450)	137 (21-330)	109 ± 19 (CuO)
7 (Grasshopper green)	162 ± 51 (126-208)	277 (81-1350)	46 (18-56) 405 (50-1200)	110 ± 17 (Cu-phthalocyanine) 226 ± 14 (Al ₂ O ₃) 466 ± 179 (TiO ₂)

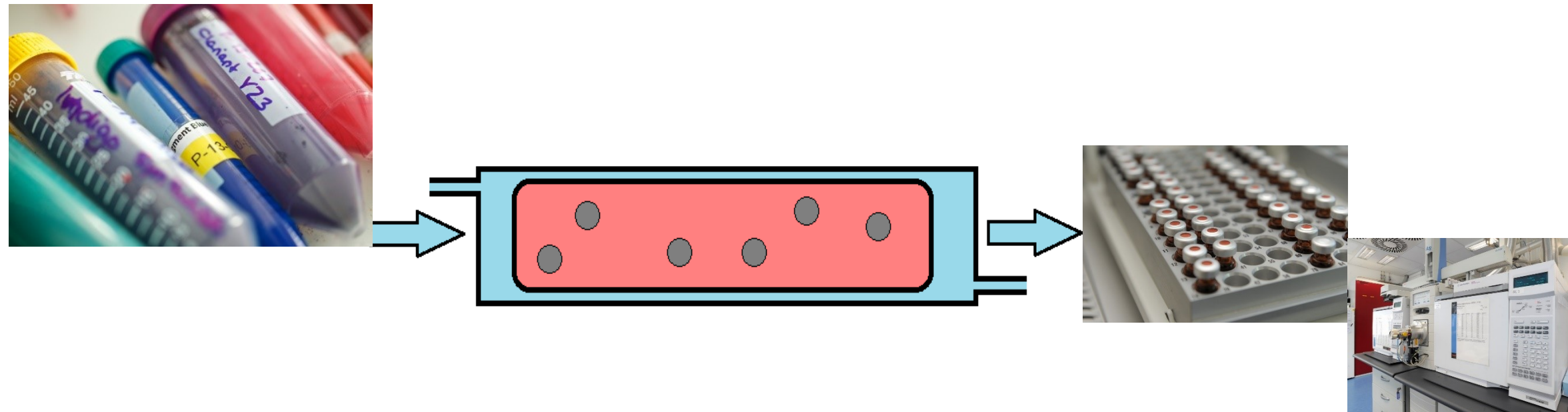
^a Diameter, median ± median absolute deviation (first-third quartile). ^b Larger particles (100-450 nm) were also observed. ^c D_h , hydrodynamic diameter, mean (range). ^d R_g , radius of gyration (=diameter of gyration (D_g)/2), mean (range). ^e Diameter, mean ± standard deviation.

Ink	Peak	Rt (min)	Rg (nm)	< 100 nm
Ice blue	1	17-28	42 (16-65)	53%
	2	28-56	269 (60-490)	
Deep Violet	1	15-32	56 (11-100)	78%
	2	32-54	271 (100-490)	
Black Outlining	1	17-50	137 (21-330)	77%
	1	16-27	46 (18-56)	32%
Grasshopper Green	2	27-56	405 (50-1200)	

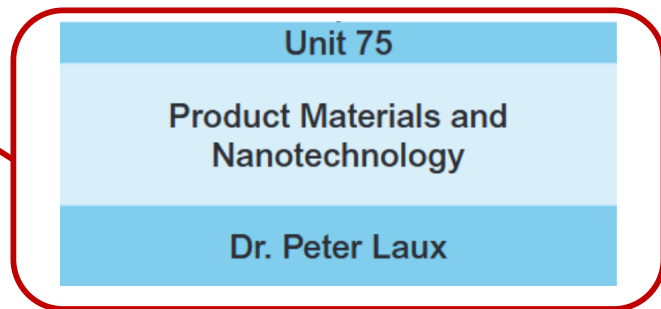
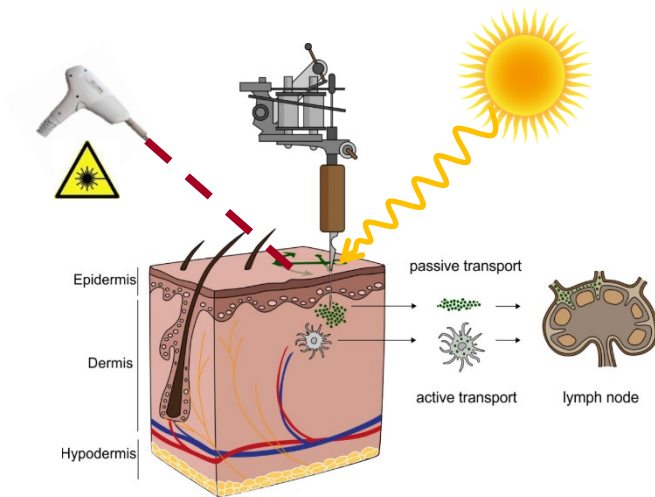
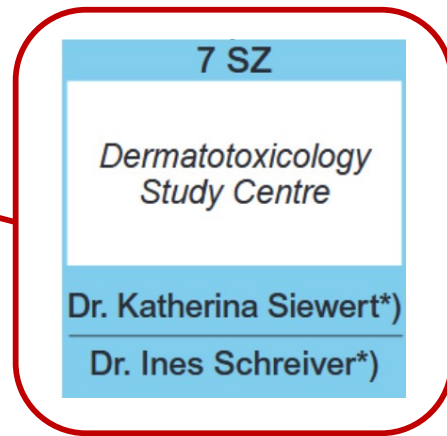
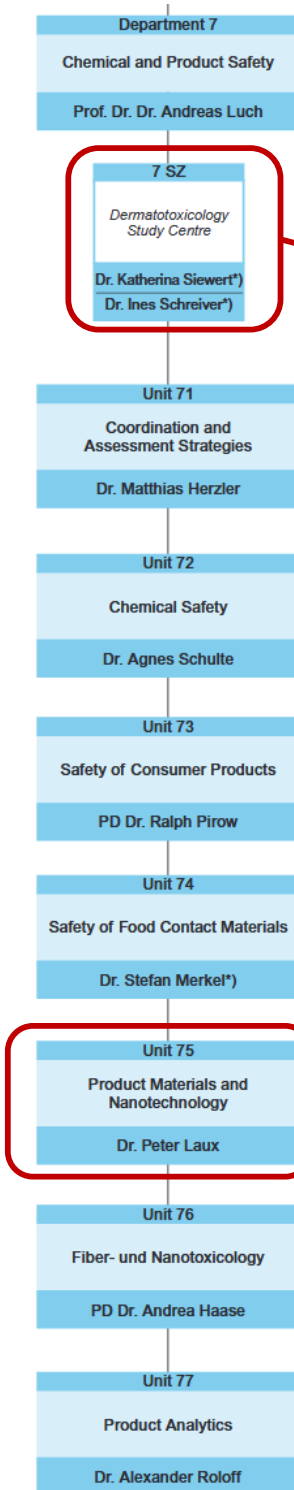
Bocca et al (2017) Journal of Analytical Atomic Spectrometry 32(3):616-628
Battistini et al (2020) Chemosphere 245:125667

In-vitro approach for investigation of pigment dissolution

- Long-term dynamic dissolution testing of tattoo pigments in skin simulant
- External factors like UV or temperature
- Fractionated sampling and analysis of pigments and/or metabolites
- Identification of pigments that release harmful substances under physiological conditions



Activities of the BfR on tattoo ink safety (selection)



www.bfr.bund.de



Infection Risks through Tattooing

www.bfr.bund.de



people in the west-
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the growing number
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FAQ about tattoo inks

Updated BfR FAQ, 16 September 2019

In Germany, roughly 12 p
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DOI 10.17590/20201006-102053

Tattoo inks: risk assessment for Pigment Blue 15:3 and Pigment Green 7

BfR Opinion No 039/2020 issued 8 September 2020

To date, there is no binding regulation governing the components used in tattoo inks at the European level. The EU Commission and member states are currently consulting on a pro-

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DOI 10.17590/20211021-115214

Tattoo inks: minimum requirements and test methods

Opinion No 031/2021 of the BfR of 14 October 2021

Tattoo inks contain pigments and additives. According to the provisions of the German Food, Consumer Goods and Feed Code (Lebensmittel-, Bedarfsgegenstände- und Futtermittelge-
setzbuch, LFGB), tattoo inks may not be used if there is any doubt as to their safety to
health. Substances or mixtures for tattooing purposes are regulated in the REACH Regula-
tion [entry 75 of Annex XVII of the REACH Regulation (Regulation (EC) No 1907/2006)].



<https://www.philara.de/en/exhibitions/2021-02/timm-ulrichs>

**Thank you for your
attention**



Identify Risks –
Protect Health

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