Skin barrier function in infants - new challenges and new opportunities

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Question Asked circa 2000

- What can we find out about healthy infant skin by studying it *in vivo* with new non-invasive tools

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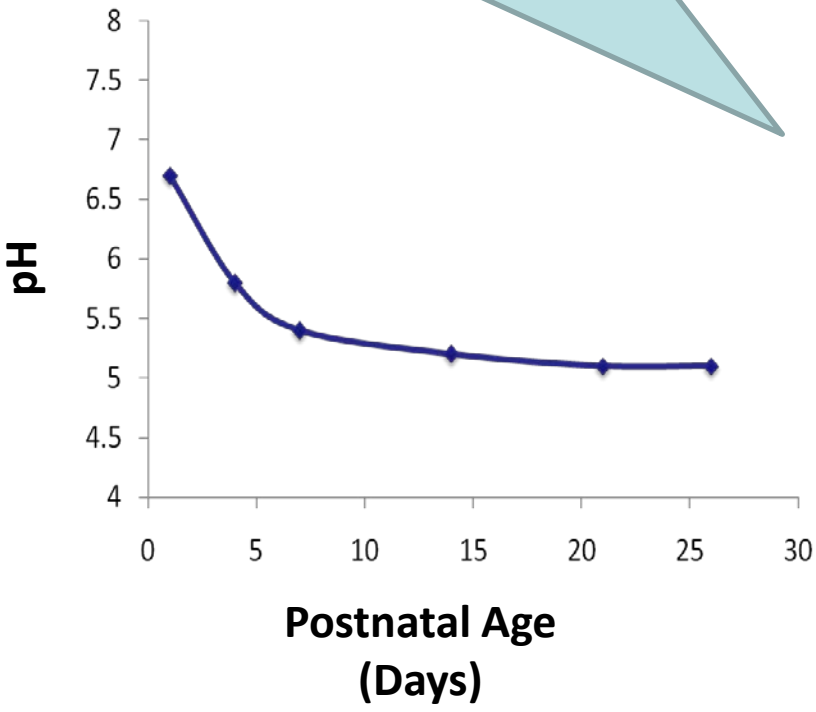
State of knowledge … then…

At birth, infant skin undergoes a dramatic transition from an aqueous to a dry terrestrial environment



… but if left on its own after a few short weeks, the skin barrier is fully established (equivalent to adult barrier).

Visscher M, et al. *Pediatr Dermatol.* 2000;17:45-51
Mauro T, Behne M. In: *Neonatal Skin: Structure and Function.* 2003:47-56

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State of knowledge … and now… (punchline)

Compared With Adult Skin, Baby Skin Structure, Composition, and Function Are Different and Continue to Develop After Birth

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Enablers (a.k.a. non-invasive methods)

Traditional

- Electrical properties ~ SC hydration
- TEWL ~ SC water barrier function
- pH electrode ~ skin surface acidity

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Enablers (a.k.a. non-invasive methods)

More modern

- **Optical methods**
  - **Spectroscopy**
    - **Reflectance**
    - **Infra Red**
    - **Raman**
  - **Imaging**
    - **Visible**
    - **Fluore-scence**
  - **Microscopy**
    - **Video**
    - **Confocal**

Stamatas GN in *Textbook of Aging*, Chapter 69, 2010; 715-724

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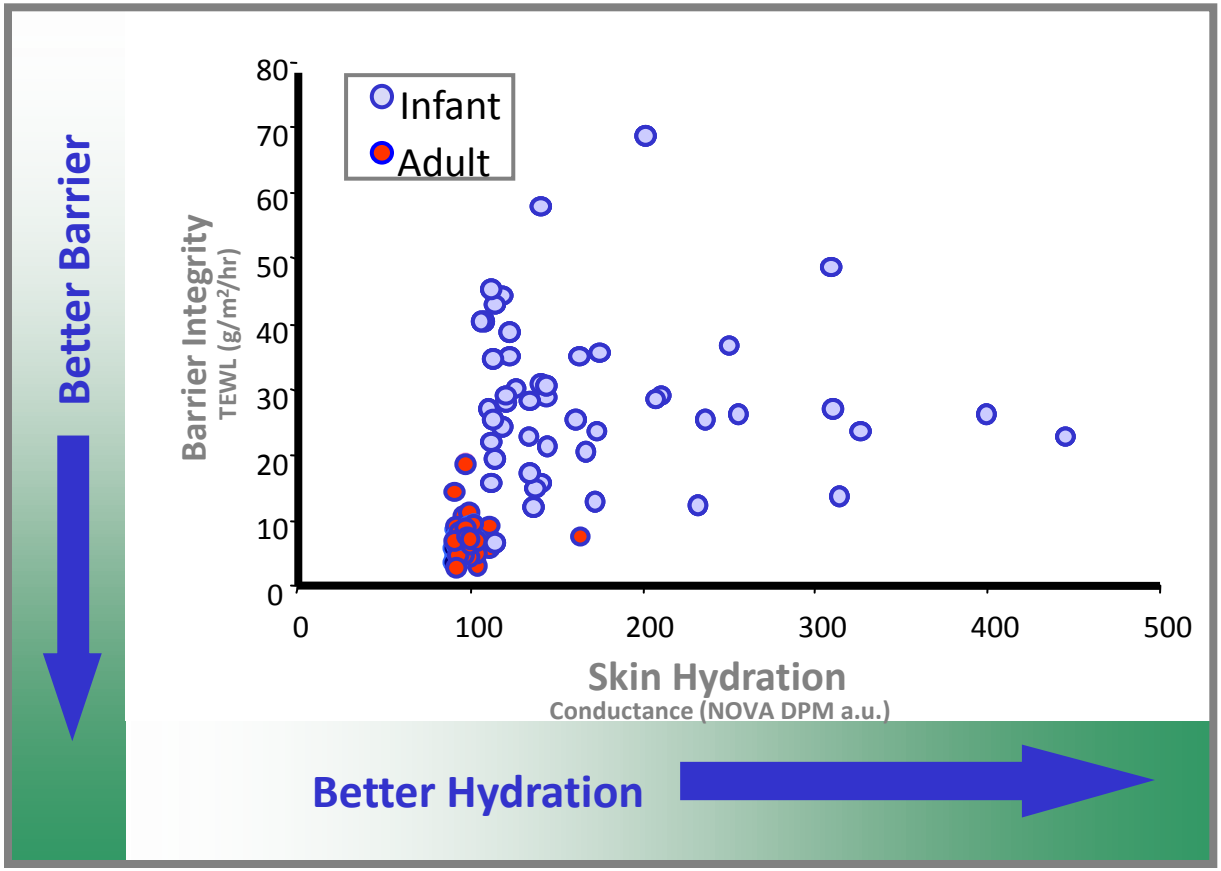
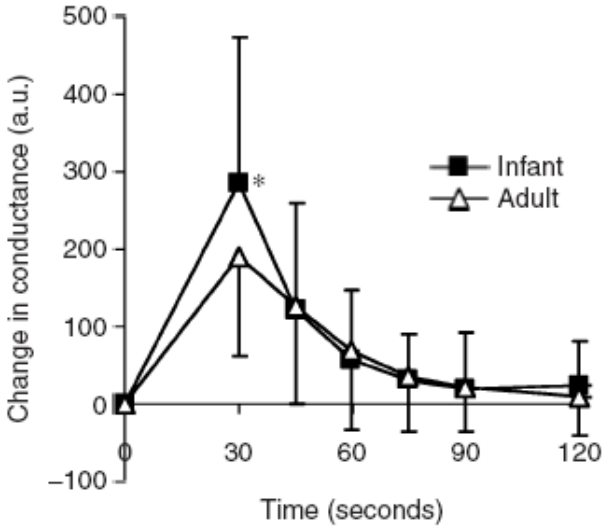
Function

Skin Barrier Maturation



Water absorption-desorption



Nikolovski J et al. *Journal of Investigative Dermatology* 2008:128; 1728-1735

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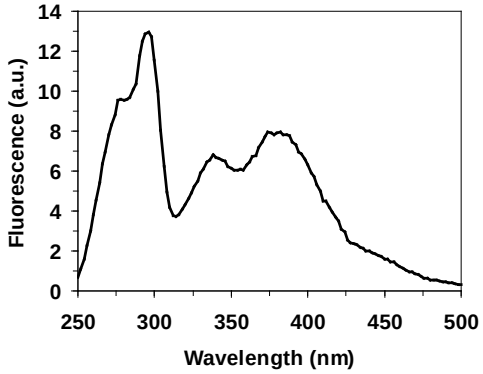
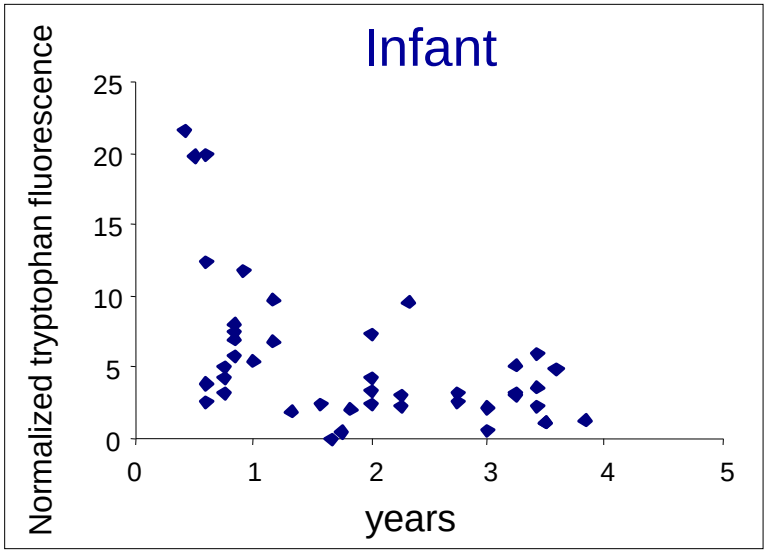
Function

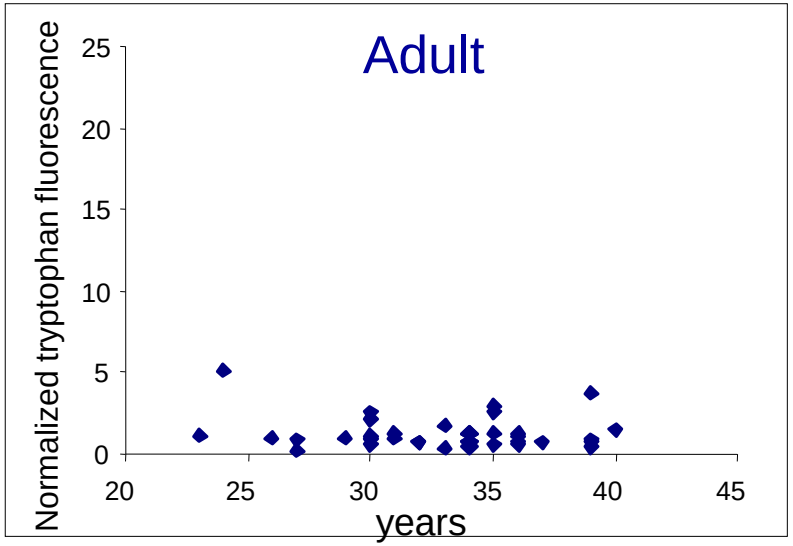
Higher cell turnover rates



In vivo Fluorescence Spectroscopy

✓**Skin Native Fluorophores: tyrosine, tryptophan, collagen x-links, elastin x-links**





Stamatas, GN et al. *Pediatric Dermatology* 2010: 27(2), 125-131

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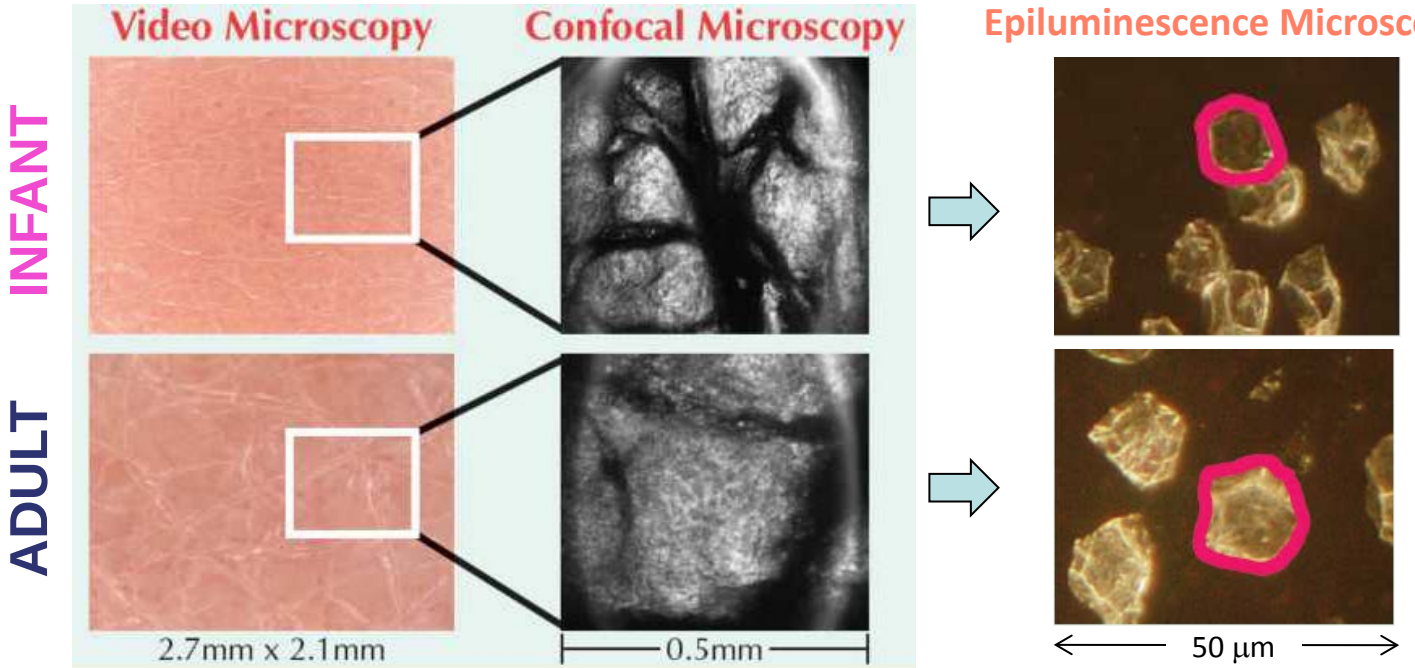
Structure

Denser Glyphics, smaller Cells, thinner Layers



	Stratum Corneum Thickness (mm)	Epidermis Thickness (mm)
Infant	7.3 ± 1.1	28.7 ± 3.4
Adult	10.5 ± 2.1	36.2 ± 5.2

Stamatas, GN et al. *Pediatric Dermatology* 2010: 27(2), 125-131

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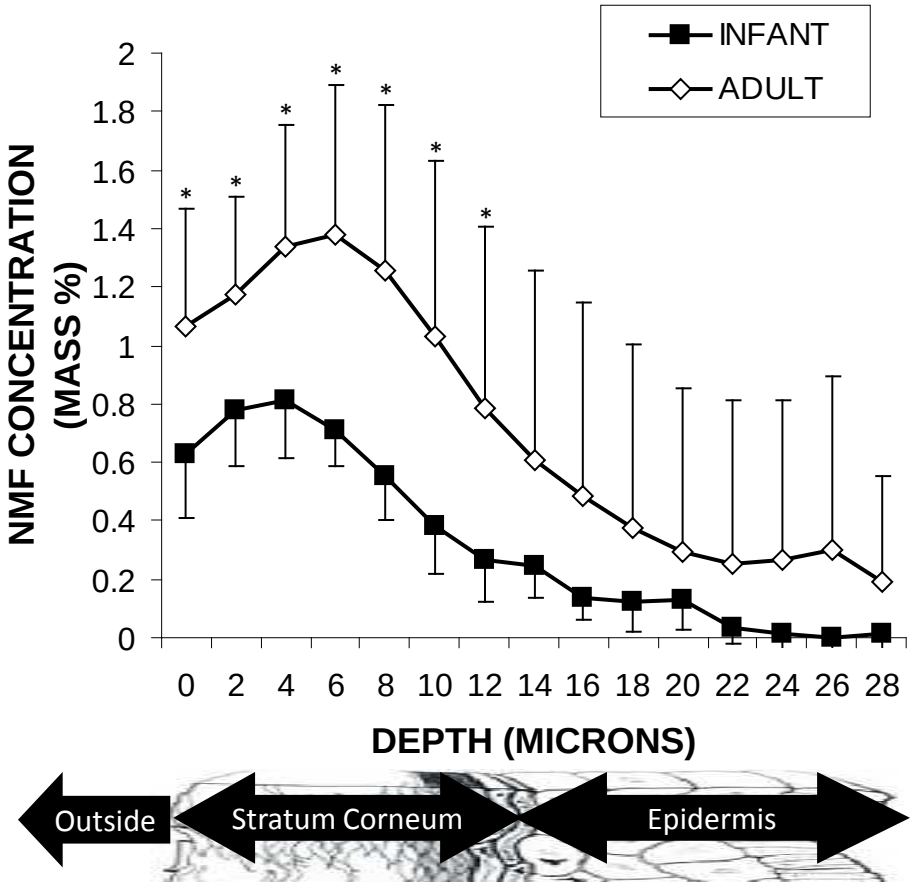
Composition

Less aminoacids, more lactate



	Infant	Adult
Keratin	=	=
Ceramide	=	=
Cholesterol	=	=
Lipid/Protein	=	=
Ala	-	+
Gly	-	+
His	(-)	(+)
Arg + Orn + Cit	-	+
Pro	=	=
Ser	=	=
Lactate	+	-
PCA	=	=
Urea	=	=
Trans-UCA	(-)	(+)

Nikolovski J et al. *Journal of Investigative Dermatology* 2008:128; 1728-1735
Stamatas GN et al. presented at the World Congress of Dermatology, Seoul, S. Korea, May 2011

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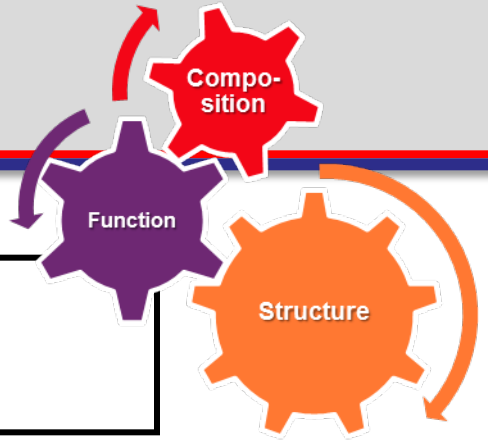
In Summary …so far



Infant Skin Undergoes
a Maturation Process

Structure

- Stratum Corneum and Epidermal thickness
- Corneocyte size
- Surface Roughness
- Collagen in the dermis
- Elasticity

Composition

- Water content
- Natural Moisturizing Factor (NMF)
- Melanin
- Lipid content and organization

Function

- Water Handling Properties
- Barrier Function
- Skin Reactivity
- Cell Proliferation

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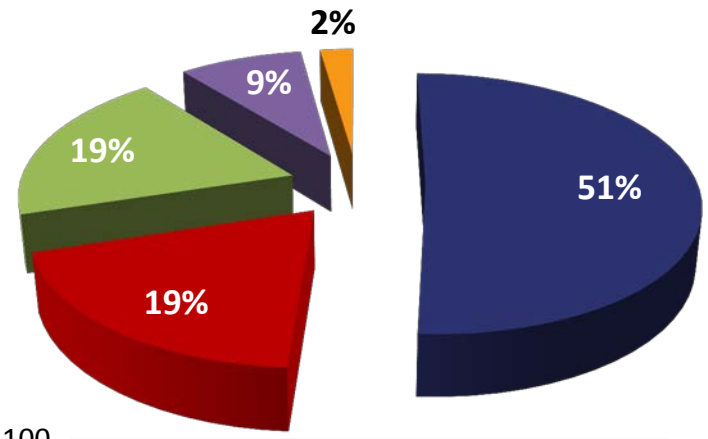
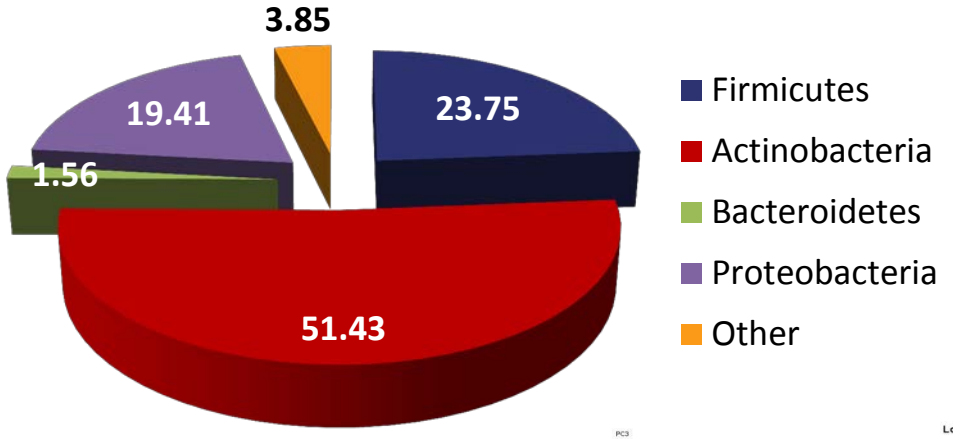
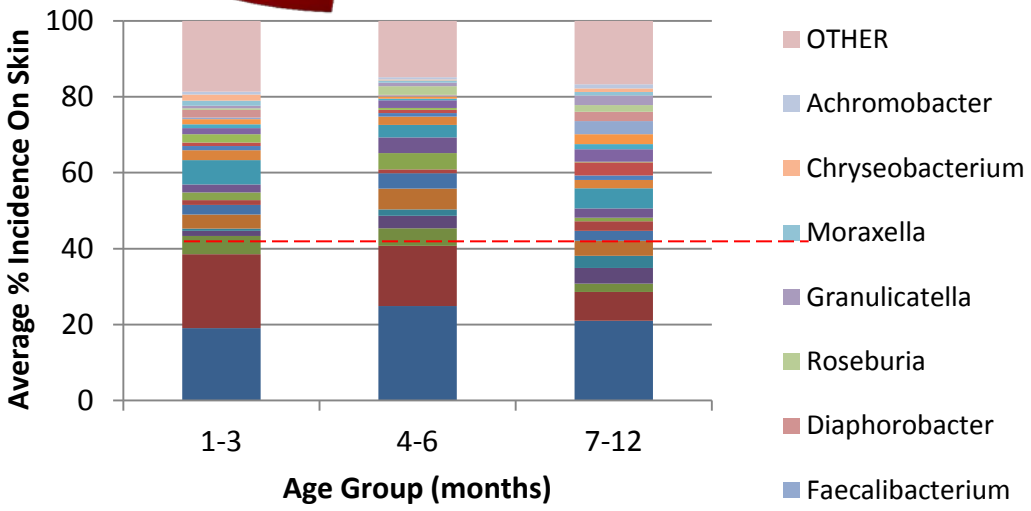
Microbiome

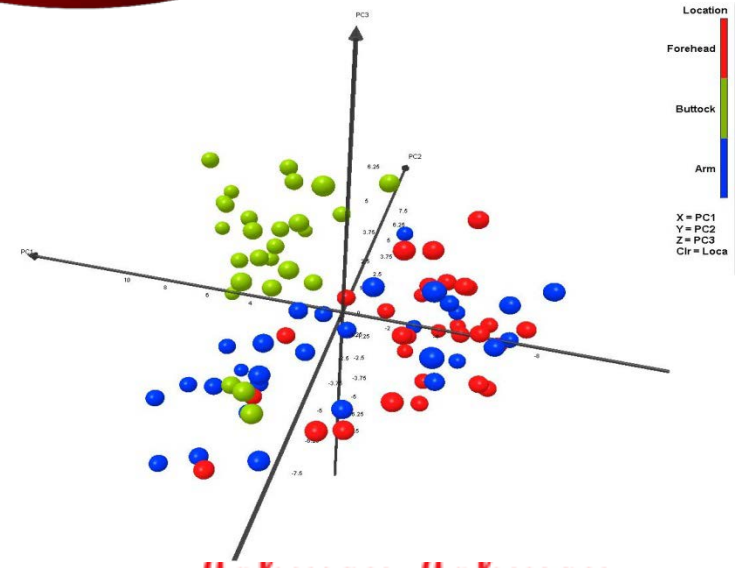
Infant Phylum Percentages



Adult Phylum Percentages







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Gao, et al. *Proc Natl Acad Sci.* 2007;104:2927-2932

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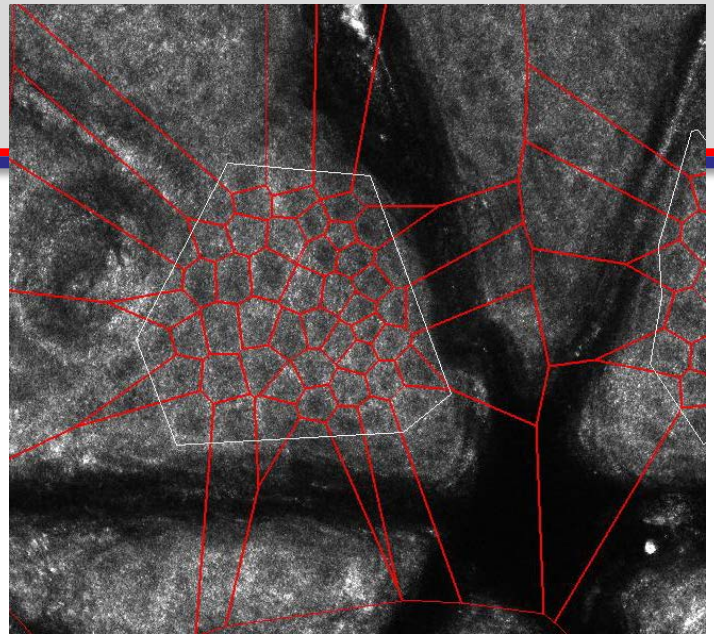
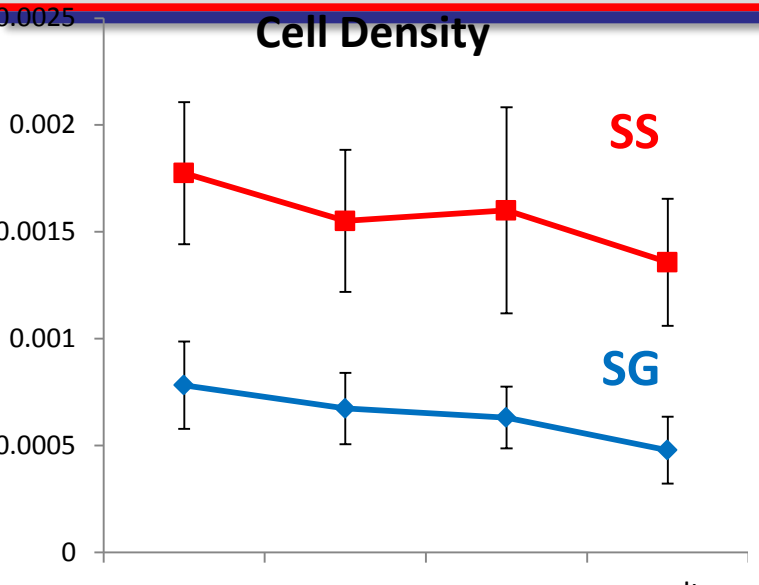
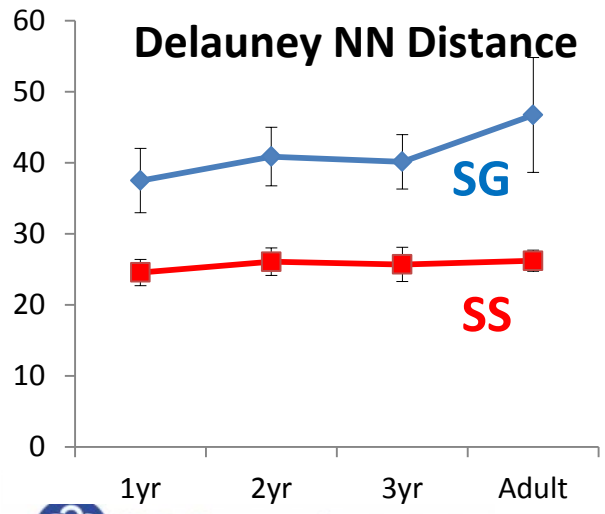
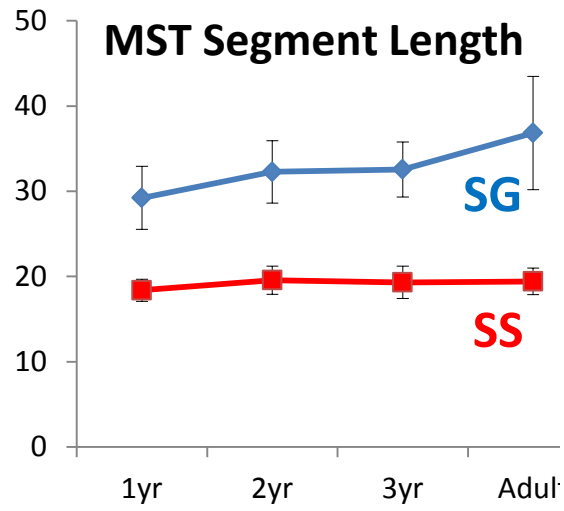
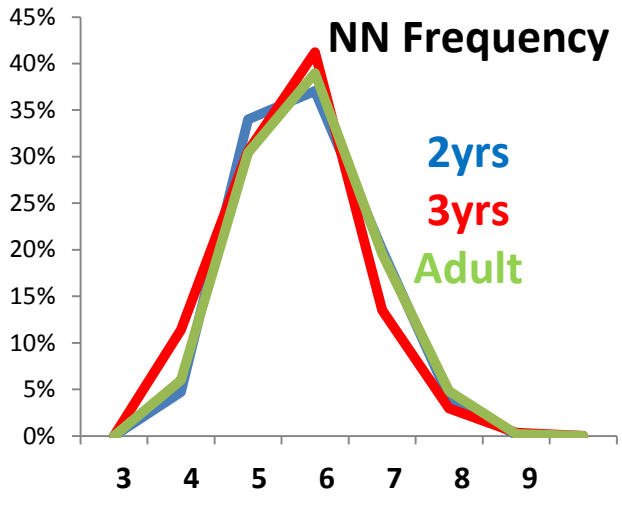
Topology











BC Cancer Agency
CARE + RESEARCH
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Stamatas GN et al. Presented at the European Academy of Dermatology and Venereology, Spring meeting, 2014

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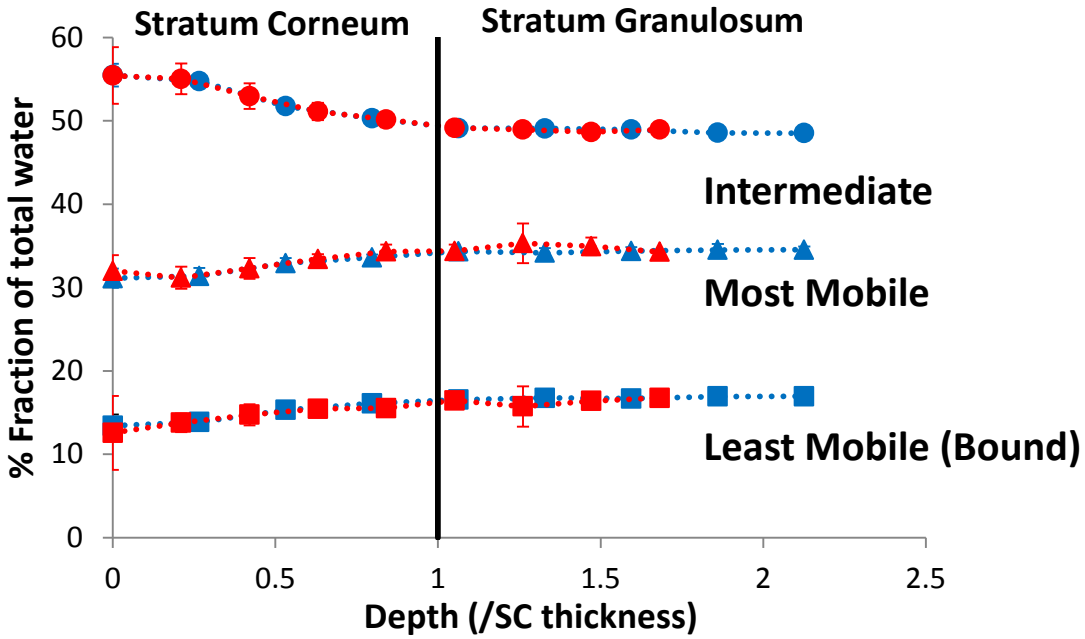
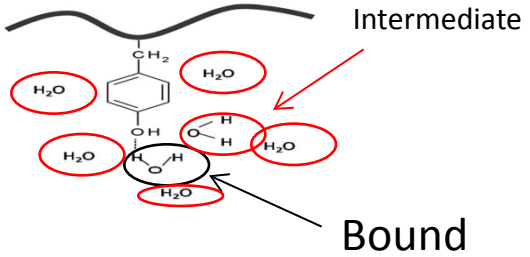
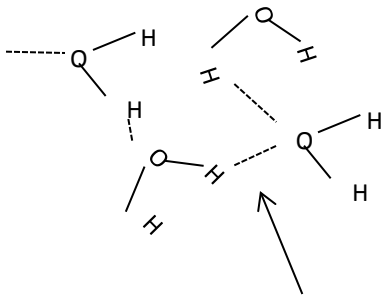
Water Mobility







Boireau-Adamezyk et al. *Journal of Investigative Dermatology* 2014:134; 2046–2049

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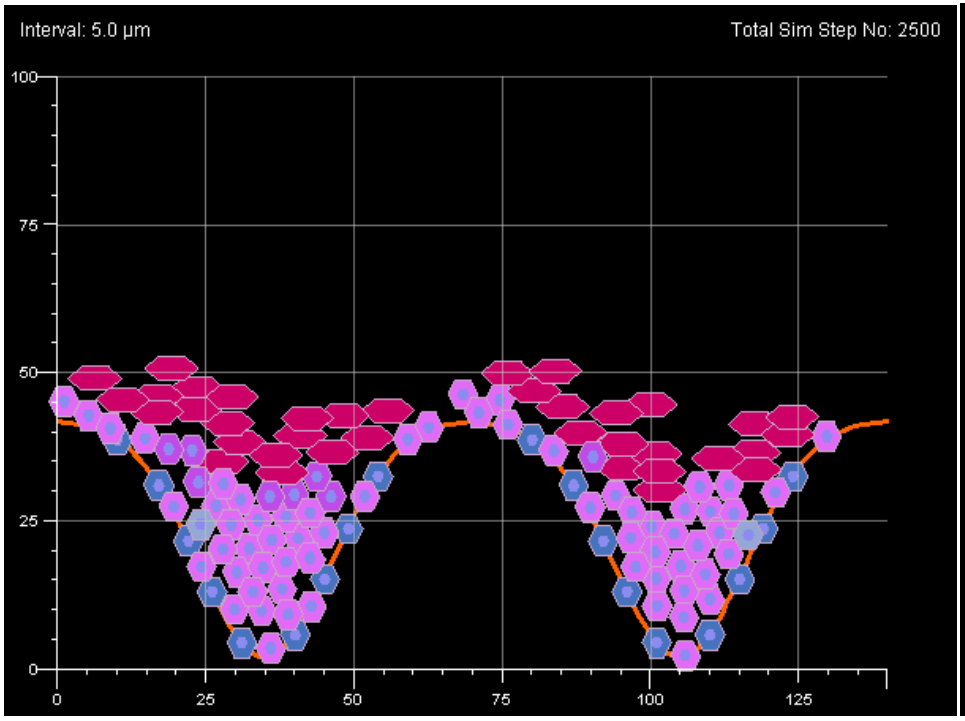
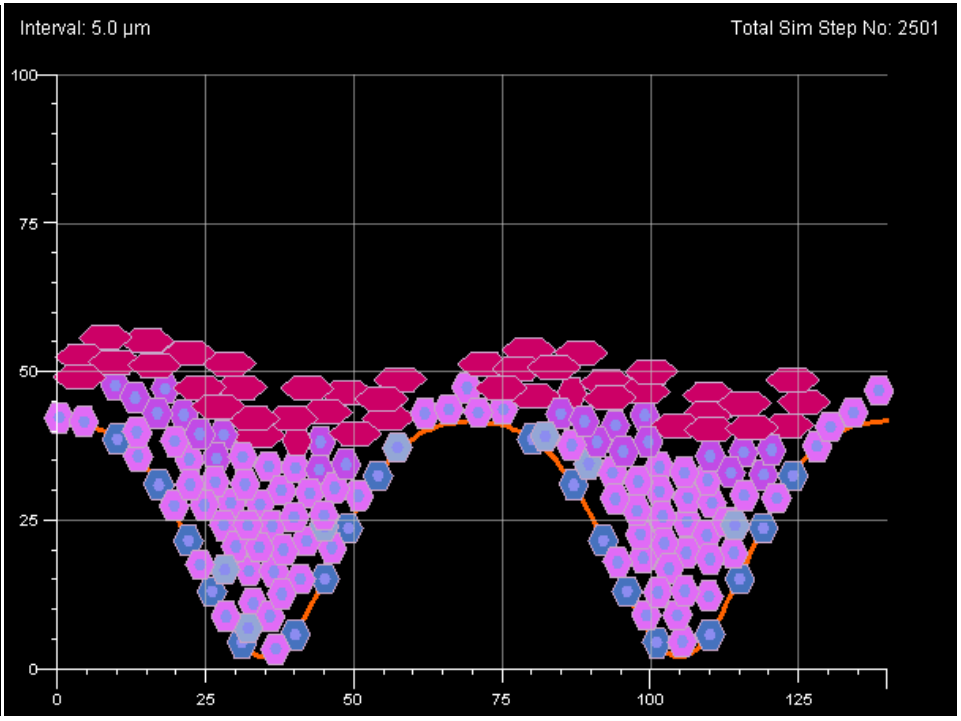
Modeling (Part 1: Structure)

Baby skin (simulation)



Adult skin (simulation)



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Seit 1386.

Suetterlin et al. Bioinformatics, 2009:25(16); 2057–2063

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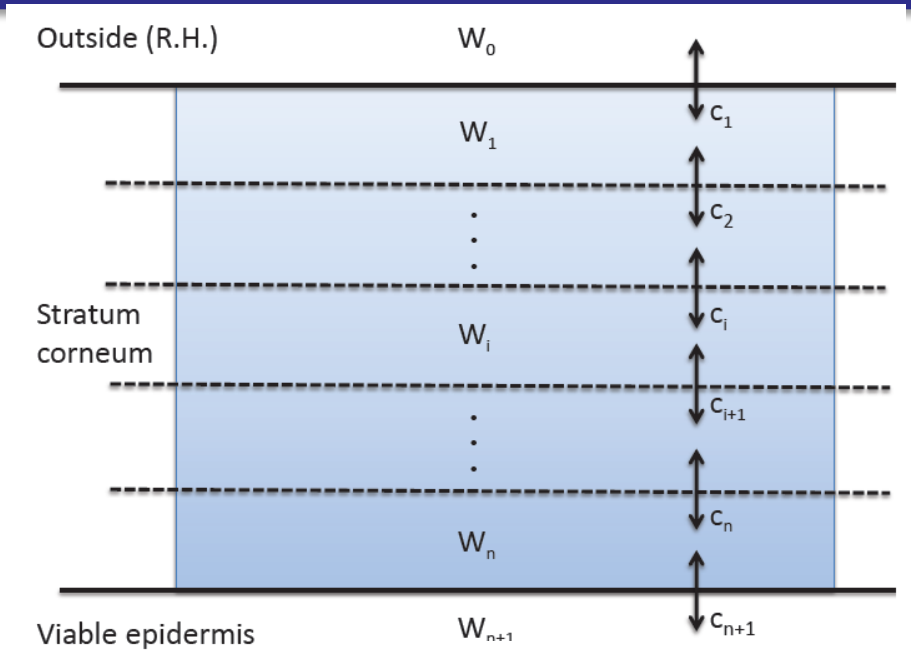
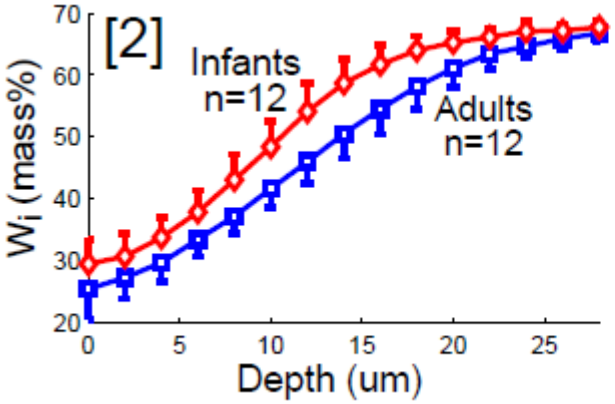
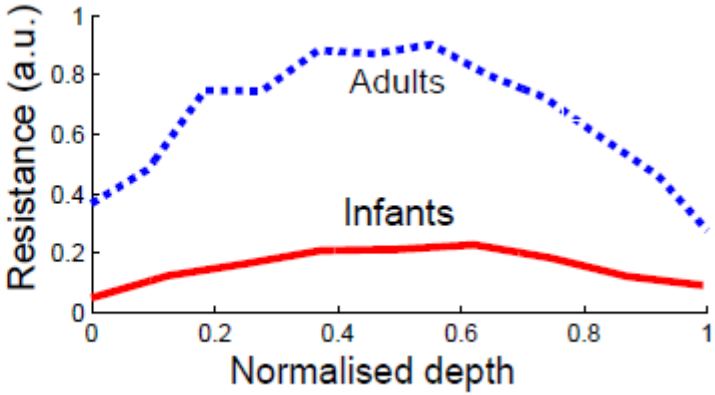
Modeling (Part 2: Function)



$$\bar{W}_i = -\frac{W_0 \sum_{k=i+1}^{n+1} \frac{1}{c_k} + W_{n+1} \sum_{k=1}^{i} \frac{1}{c_k}}{\sum_{k=1}^{n+1} \frac{1}{c_k}} = -\frac{W_0 R_L^{(i)} + W_{n+1} R_U^{(i)}}{R_L^{(i)} + R_U^{(i)}}.$$





Van Logtestijn et al. presented at Skin Forum meeting 2014

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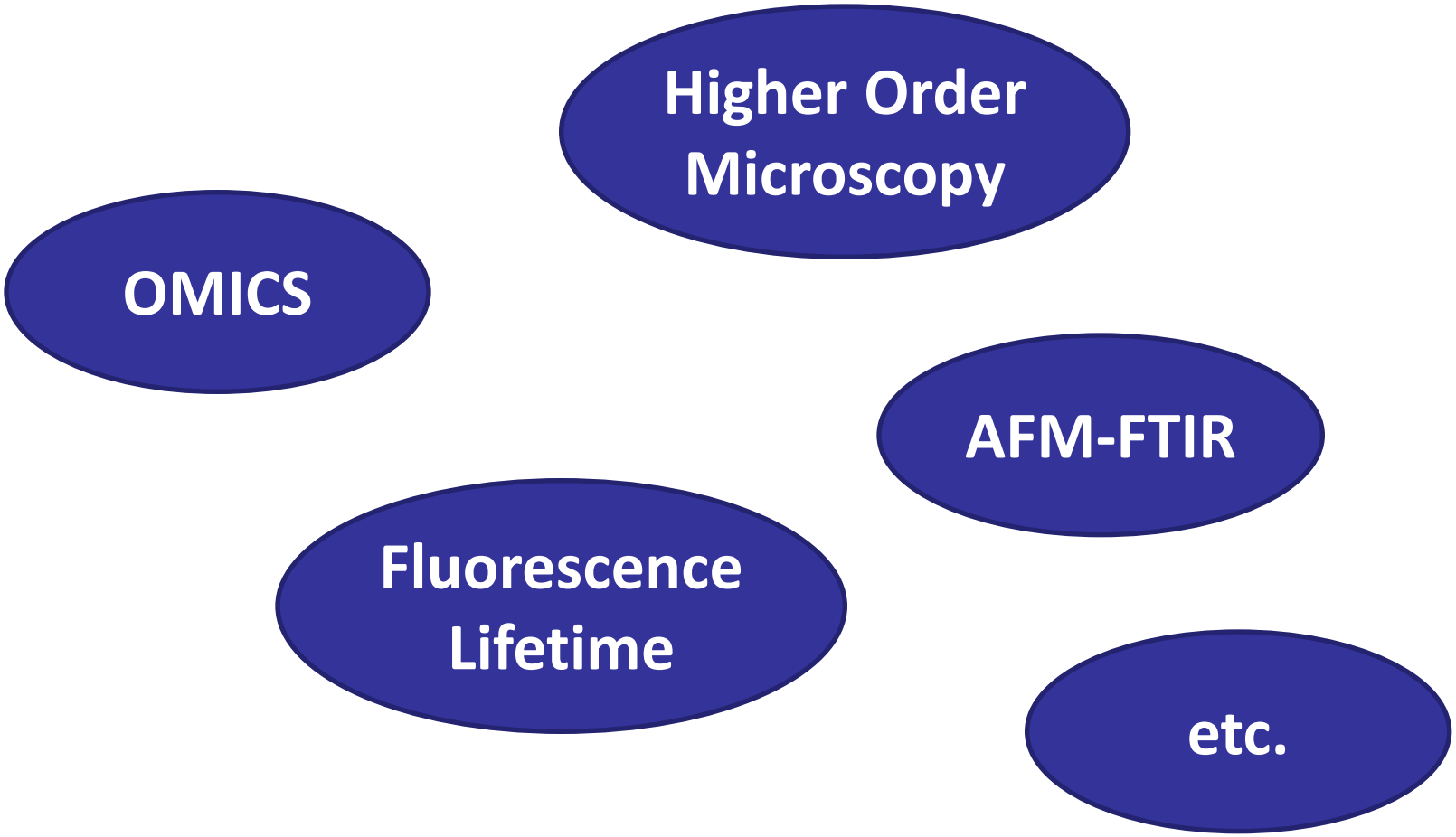
The Future: new tools – new insights



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