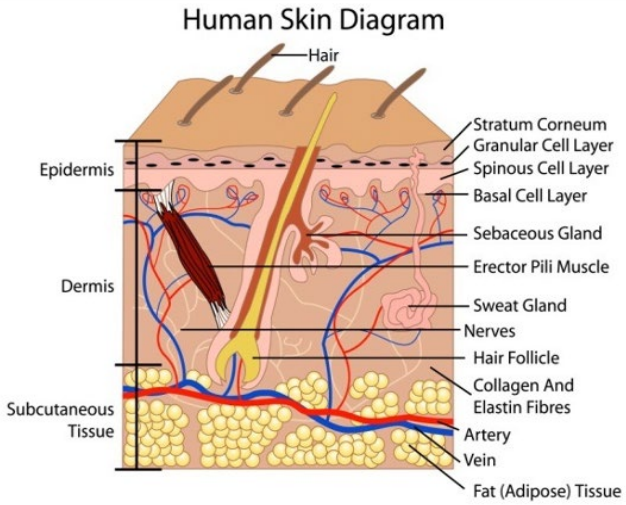
Unique Differences of Infant Skin, its Microbiome, and How to Support Normal Skin Maturation

The Skin Is Our Natural Protective Barrier



- **Protects** from injury, external environment, pathogens.
- **Regulates** temperature.
- **Helps manage** water loss.
- **Provides sensory perception.**

Maintaining Skin Barrier Integrity is Essential

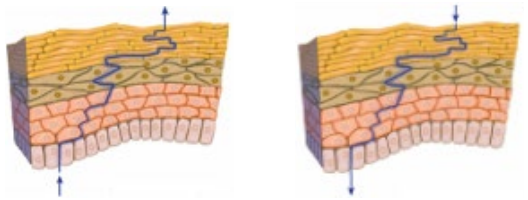
Measured by:

- Skin's ability to hold onto water -TEWL (transepidermal water loss)
- Skin Hydration
- Skin pH (acid mantle) – protective, mildly acidic, supports resident flora & inhibits pathogens

1. Irving V. J Wound Care 2001, 10:253-6. 2. Nikolovski J et al. J Invest Dermatol 2008, 128:1728-36.

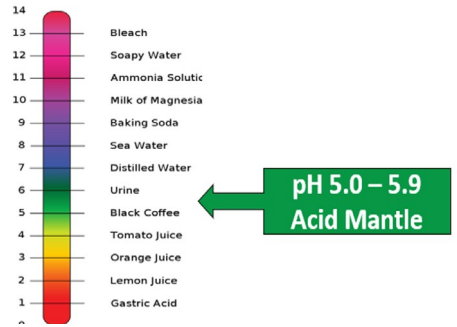
Infant's Skin is Uniquely Different and Develops Over First Years

Structure and **composition** differences lead to **functional** differences



- Infant skin can lose water 2x as fast.
- Smaller cells and thinner skin - shorter pathway outside to inside.

Infant skin pH 6.0 at birth, quickly becomes mildly acidic.

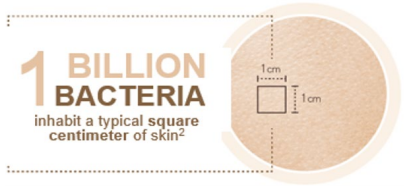


1. Stamatas G, et al. Pediatr Dermatol. Mar-Apr 2010;27(2):125-31.
2. Nikolovski J, et al. J Invest Dermatol. 2008;128:1728-1735 3. Mack M, et al. J Invest Dermatol. 2009;129(S1):S143
4. L.S Telofski et al. Dermatology Research and Practice, vol 2012. 2. G.N. Stamatas et al. International Journal of Cosmetic Science, 2011, 33, 17-24
5. Behrendt, H. and M. Green. "Patterns of skin pH from birth through adolescence : with a synopsis on skin growth." (1971).

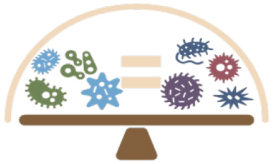
The Skin Microbiome Provides Essential First Line of Defense

The Skin Microbiome

Skin is an **ecosystem; microbiome** works with skin barrier.



Healthy skin inhabited by **harmless microbes**; helps **protect against harmful** microbes.

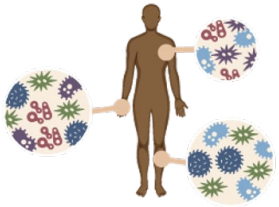


A Balanced Microbiome

The skin microbiome is a habitat of billions of beneficial and harmful bacteria. An imbalance of these bacteria can lead to a variety of skin conditions including acne, eczema, rosacea and aging.[1]

pH Balance

The skin microbiome prefers a relatively acidic environment (pH around 5.0) which also inhibits growth of pathogens.[1]



Bacterial Diversity Differs by Body Zone

Differences in skin temperature, texture, thickness, humidity and chemistry help determine which kinds of microbes live where on the skin.[1]

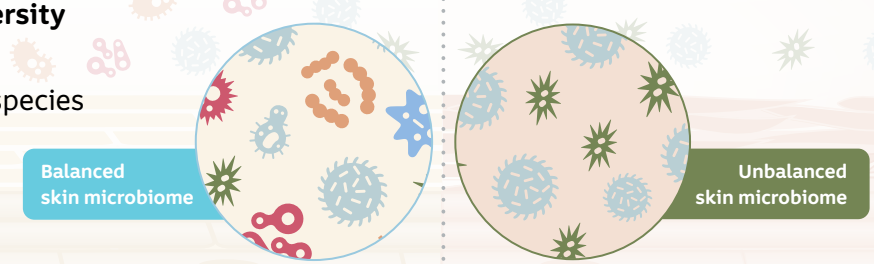
1. EA Grice, JA Segre, Nat Rev Microbiol 2011: 9(4), 244-53.
2. EA Grice, HH Kong, G Renaud, AC Young, et al. Genome Res 2008: 18(7), 1043-50.

Skin-Microbe Relationships Are Important

Balanced microbiome supports healthy skin and imbalance between harmful & beneficial microbes may be associated with skin conditions

Goal is to enhance beneficial microbes and protect from harmful microbes

- **Balance** is key. Both **richness** and **diversity** are important.
  - Richness - Total # of bacterial species
  - Diversity - # & abundance of individual types of organisms
- Healthy microbiome **prefers acidic environment** (about pH 5.0) which also inhibits pathogens.



Diversity of microbes is linked to some human diseases

- C. difficile colitis — Lack of diversity; monocolonization *C. difficile*
- Atopic Dermatitis Lesions — Low diversity; increase in *S. aureus*
- Diseased state may be associated with absence of commensal bacteria

Dysbiosis (disbī'ōsəs) - alterations; imbalance in skin microbiota

Byrd, A., Belkaid, Y. & Segre, J. The human skin microbiome. Nat Rev Microbiol 16, 143–155 (2018).
EA Grice, JA Segre, Nat Rev Microbiol 2011: 9(4), 244-53.
EA Grice, HH Kong, G Renaud, AC Young, et al. Genome Res 2008: 18(7), 1043-50.

Atopic Dermatitis is Characterized by a Disrupted Skin Barrier Which May be Associated With Skin Microbiome Imbalance (Dysbiosis)

What is Atopic Dermatitis?

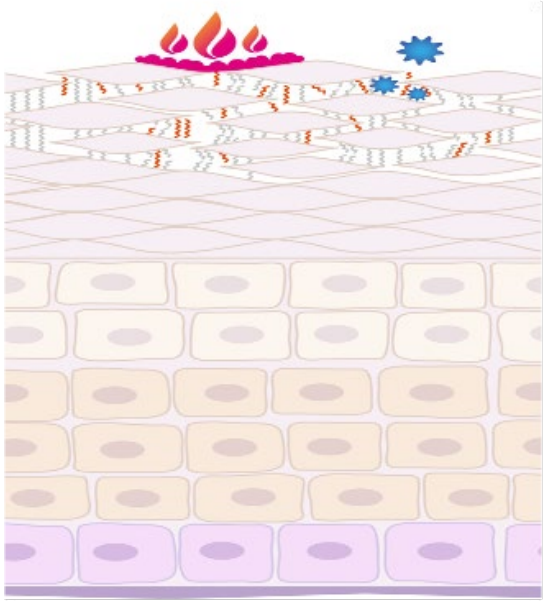
- Chronic, relapsing inflammatory disease
- Often highly pruritic (itch is a hallmark sign)
- Typical eczematous pattern; changes with age
- Skin appearance at lesional sites - redness (lighter skin tones); darker than surrounding skin (darker skin tones)

Atopic Dermatitis (Eczema) Facts

- Up to 20% of children globally
  - 1 in 5 children (UK)
  - 10% of population (US)
    - ~10 Million Children
- All ethnicities
- 45% of all AD develops in first 6 months
- Family history is strongly associated with AD

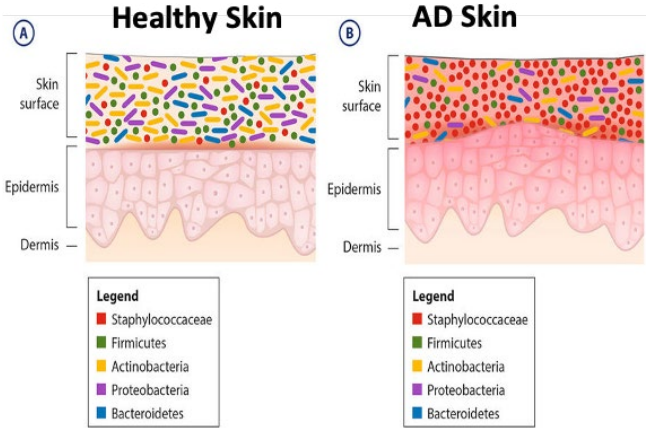
Asher MI, et al. Lancet 2006;368:733-743. Chiesa et al, J Invest Dermatol. 2019;139(3):583-590. Tolefson et al, Pediatrics 2014;134(6):e1735-1744.
https://www.eczema.org https://www.nationaleczema.org/research/eczema-facts/

Breakdown of skin barrier, lipids disrupted, permits entry of allergens, irritants; bacteria has access



- Decreased epidermal lipids
- Filaggrin mutations
- Impaired innate immunity
- Increased transepidermal water loss
- Elevated skin pH (lesions)

Alterations or **imbalance** in skin microbiota such as reduced diversity and increased bacteria; can result in secondary infection



Skin Microbiome Diversity ↓

Staphylococcus aureus ↑

Brandwein et al Biofilms & Microbiomes 2016

Bjerre, et al. The role of the skin microbiome in atopic dermatitis: a systematic review. Br J Dermatol. 2017;177(5):1272-1278.
Cork MJ, et al. J Invest Dermatol 2009; 129: 1892–908.
Kong, HH. et al. Genome Res. 2012 May;22(5):850-9

Key Takeaways

1. Infant skin is **different** (*vs. adult skin*) and the skin and its microbiome continue to mature and develop long after birth. Skin care routines should strive to maintain the integrity of the skin barrier and support the microbiome

2. **Atopic Dermatitis is characterized by a disrupted skin barrier** which may be associated with skin microbiome imbalance (dysbiosis)

    - Skin barrier ***disruption*** is associated with Atopic Dermatitis and skin barrier breakdown leads to symptoms of dryness, itching and inflammation

    - Skin microbiome ***dysbiosis*** in Atopic Dermatitis is associated with low diversity of skin microbiota and robust colonization (i.e., increased) S. aureus, which can be linked with secondary infection