

# Skin Integrity

## Maintaining Healthy Skin Integrity

# Introduction to HEAL

Healthcare Excellence through Access and Learning (HEAL)



Coloplast®  
HEAL

The HEAL programme is a testament to Coloplast's dedication in supporting wound healing, which is the ultimate goal for patients and health care professionals (HCPs).

HEAL is a comprehensive and structured programme that is co-developed with experts in wound care from all parts of the world. The prime objective is to increase the knowledge of moist wound treatment leading to faster wound healing and better wound care for patients. The content of the course has been endorsed by the European Wound Management Association (EWMA).

The programme is designed for HCPs who are managing patients with wounds. This includes chronic wounds such as leg ulcers, pressure ulcers, diabetic foot ulcers, and also acute wounds such as burns and surgical wounds.

This series of medical e-learning modules are part of the HEAL programme. For further information regarding the HEAL programme that is available in your country, please consult the local HEAL website.

# Quizzes and final assessment

- During the course there will be questions and activities which we hope that you will find interesting.
- At the end of the course there will be a final assessment. You will need a minimum 80% of correct answers in order to pass this course and receive a certificate endorsed by EWMA.

# Learning objectives

After completing this course, you will be able to:

- define the structure and function of the skin,
- explain the factors that affect the barrier function of the skin, and
- explain the importance of maintaining skin health.

# About the author : Madeleine Flanagan

This module has been developed in cooperation with Madeleine Flanagan

Madeleine has been a Wound Specialist for over 25 years. She is the Programme Director for two specialist masters programmes in wound management and dermatology at the University of Hertfordshire, Department of Postgraduate Medicine. She supports a range of clinicians both in the UK and overseas to become specialist practitioners and establish new clinical services.



She has experience in providing a variety of research and educational activities related to wound management and dermatology and regularly participates in international conferences. She has lectured extensively in Europe, Australia, New Zealand, India, Middle East and South Africa on a variety of wound management related topics.

Madeleine has published widely and has written two textbooks on wound management and several book chapters. Her latest book “**Wound Healing and Skin Integrity: principles and practice**” is the first of its kind to combine wound management and dermatology to provide a practical resource for managing patients with a variety of skin integrity problems.

# Disclaimer

The recommendations in this educational course are a general guide to appropriate clinical practice, to be implemented by qualified health care professionals subject to their clinical judgement of each individual case and in consideration of the patient's personal preferences and available resources. Any advice as to clinical practice should be implemented in a culturally aware and respectful manner in accordance with the principles of protection, participation and partnership.

This course contains information that was accurate at the time of development. Research and technology change rapidly and the recommendations contained in this course may be inconsistent with future advances. The health care professional is responsible for maintaining a working knowledge of research and technology advances that may affect his or her clinical decision making.

Nothing in this course is intended as advice regarding coding standards or reimbursement regulations.

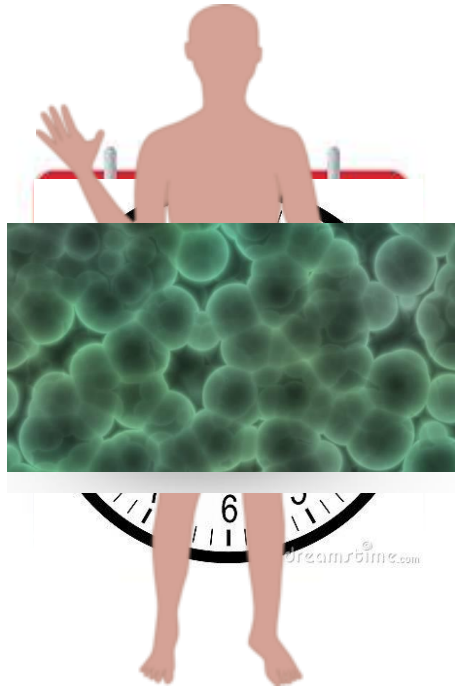
The course does not seek to provide full safety and usage information for products and devices; however commonly available safety and usage tips have been included. All products should be used according to manufacturer's directions.

The guidance provided in this course should not be considered medical advice for specific cases. This course and any recommendations within are intended for educational and informational purposes only. Nothing in this course is intended as an endorsement of a specific product.

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# The function and structure of the skin

# Facts about the skin



Naturally occurring lipids and fats keep the outer layer of the skin moist. The average person's skin when stretched out would cover 2 square metres and contains more than 11 miles of blood vessels. The skin also contains bacteria, fungi and other organisms found in soaps and body washes.



# Functions of the skin

- **Protection:** trauma, dehydration, temperature, toxins, UV light, microorganisms.
- **Maintenance of body temperature:** circulatory mechanisms, sweating, insulation.
- **Sensation:** pain , pressure, vibration, temperature.
- **Metabolism:** produces melanin, vitamin D, excretes waste e.g. sweat.
- **Communication:** facial expression, physical appearance, touch.



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**Reference:**

Langøen, A. and Bianchi, J. (2013). Chapter 2: Maintaining Skin Integrity. In M. Flanagan (Ed.), *Wound Healing and Skin Integrity. Principles and Practice* (pp. 18-32). West Sussex: John Wiley & Sons, Ltd.

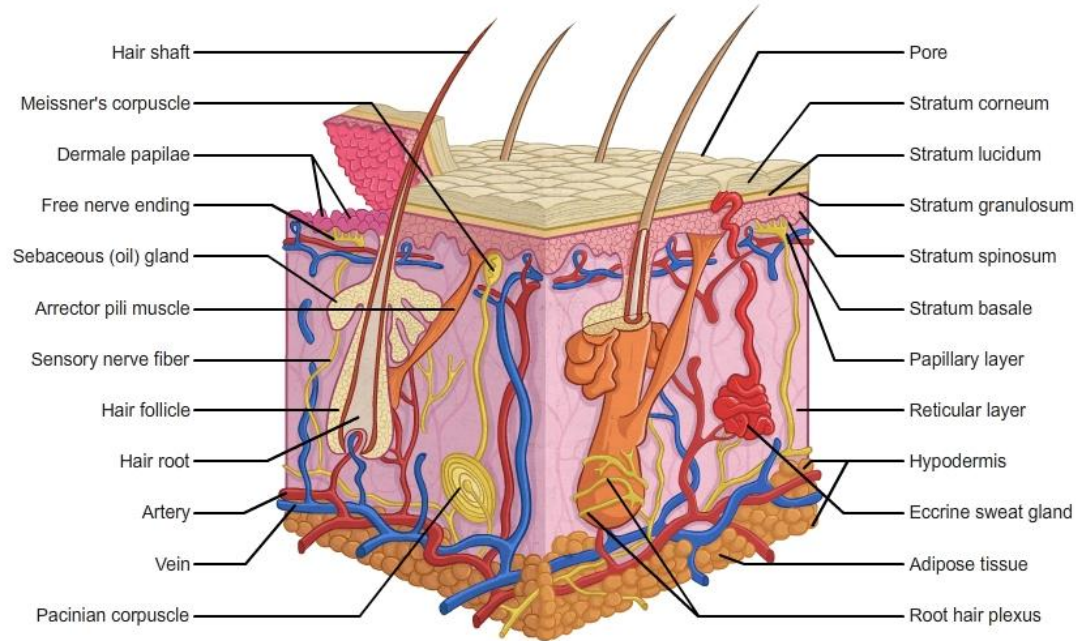
# Metabolism, sensation and communication

- Danger
- Production
- Communication



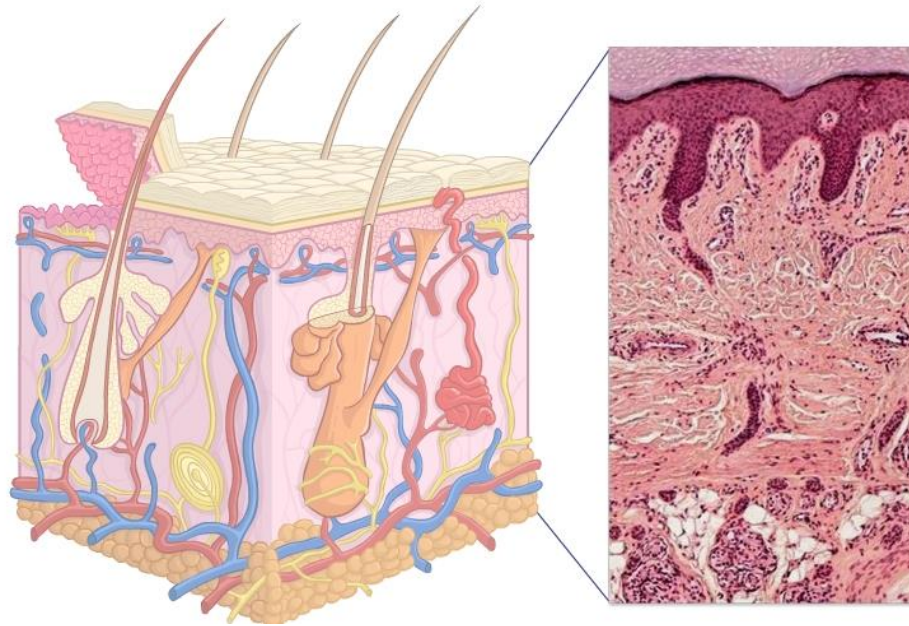
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# Full thickness skin structure



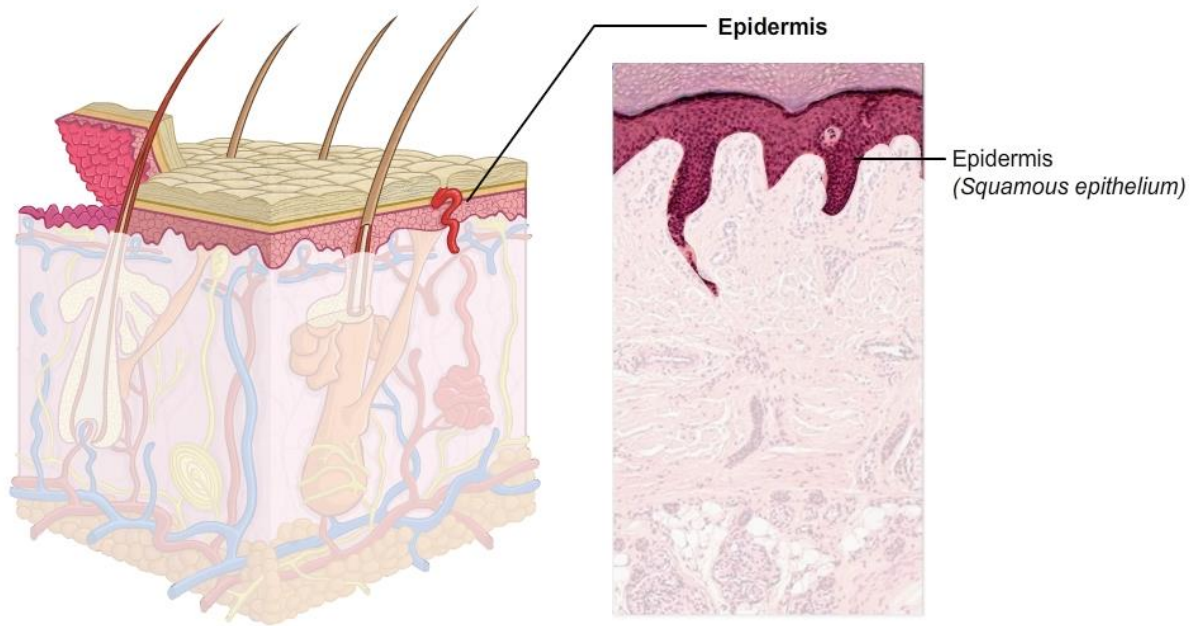
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# The three layers of the skin: Epidermis, Dermis and Subcutaneous fat



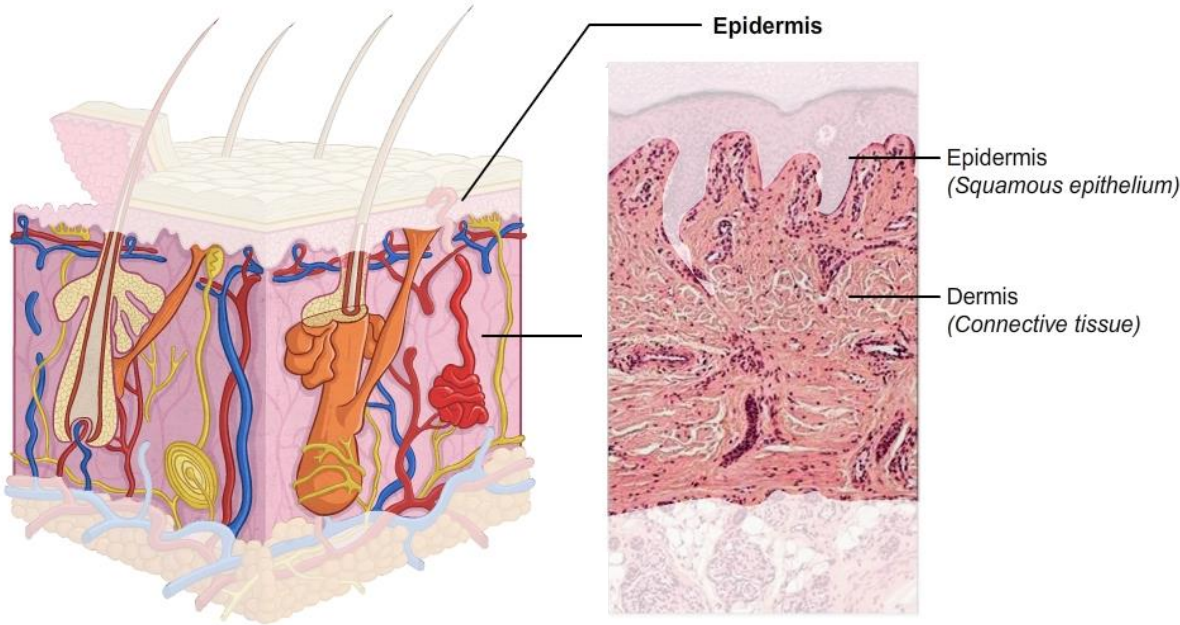
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# The three layers of the skin: Epidermis



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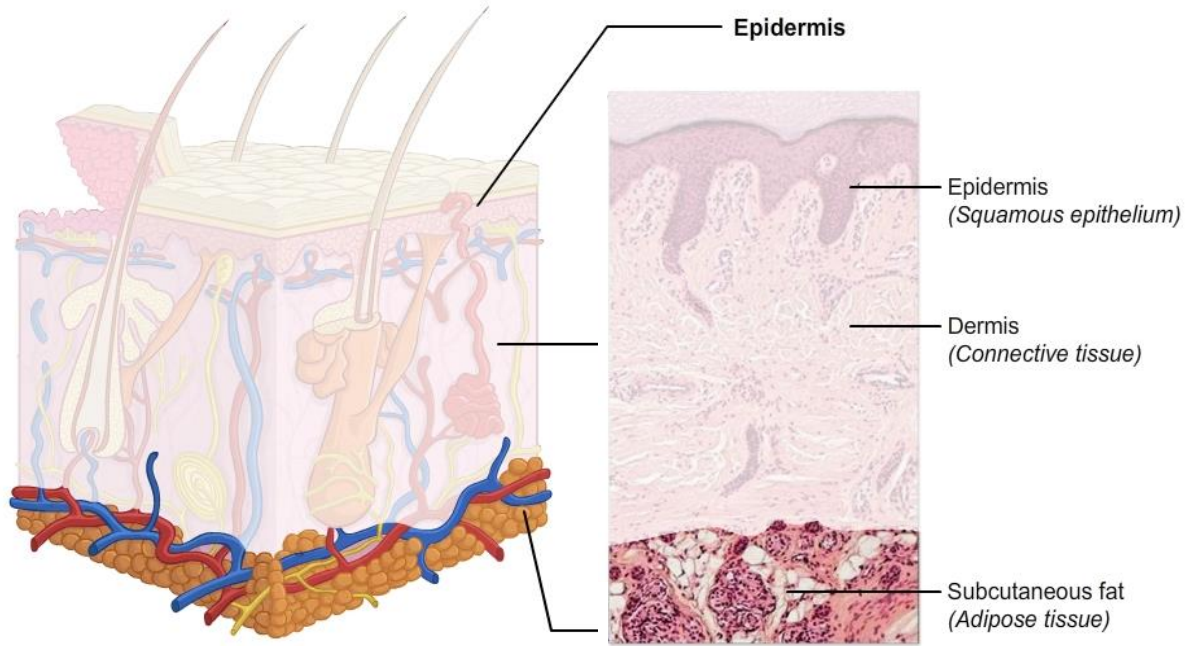
# The three layers of the skin: Dermis



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# The three layers of the skin: Subcutaneous fat

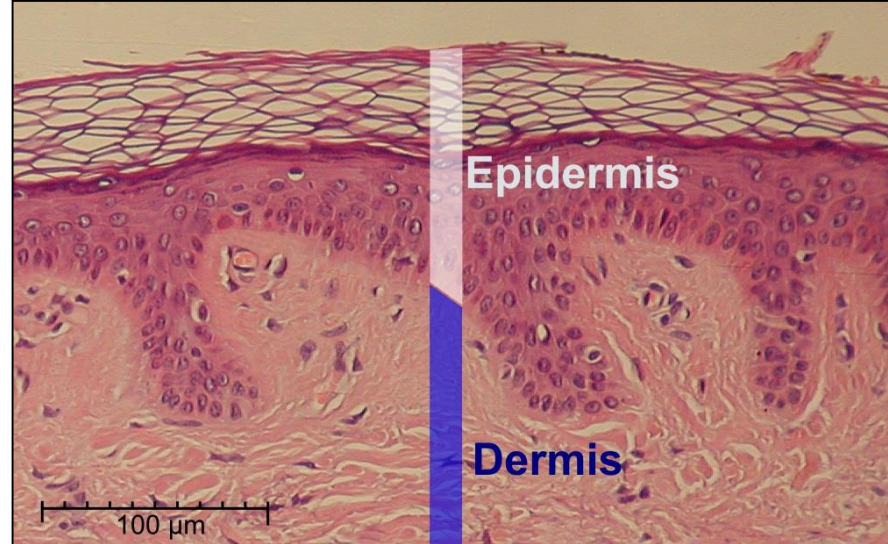


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# What is intact skin?

- In intact skin the stratum basale of the epidermis is unbroken.
- If the stratum basale is broken the vascularized dermis is exposed and the skin is no longer intact.
- Intact skin can show signs of inflammation/irritation with symptoms like redness, itching, pain, swelling and heat, and can be eroded.

This is a hematoxylin and eosin stained slide at 10x of normal epidermis

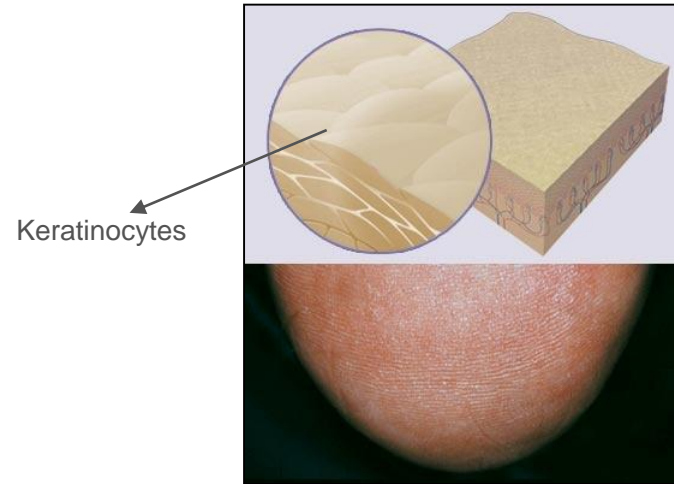


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# What is normal skin

- The main function of the epidermis is to trap moisture at the skin's surface to stop it drying out.
- The dermis is responsible for a lot of the skin's functions due to the variety of structures contained within it.
- The main function of the subcutaneous tissue is insulation and cushioning.
- Healthy skin retains moisture and has a smooth and resilient structure.



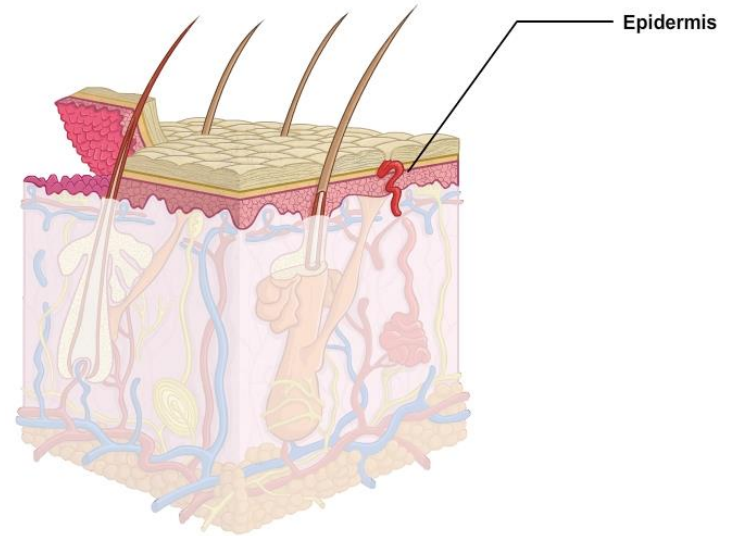
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**Reference:**

Langøen, A. and Bianchi, J. (2013). Chapter 2: Maintaining Skin Integrity. In M. Flanagan (Ed.), *Wound Healing and Skin Integrity. Principles and Practice* (pp. 18-32). West Sussex: John Wiley & Sons, Ltd.

# The epidermis

- Is the outermost visible part of the skin.
- It has a thin layer of cells varying in thickness from 0.04 mm on the eyelids to 1.6 mm on the palms and soles.
- Function of the epidermis:
  - Barrier function.
  - Control of water loss.
  - Protection against UV light, bacteria and allergens.

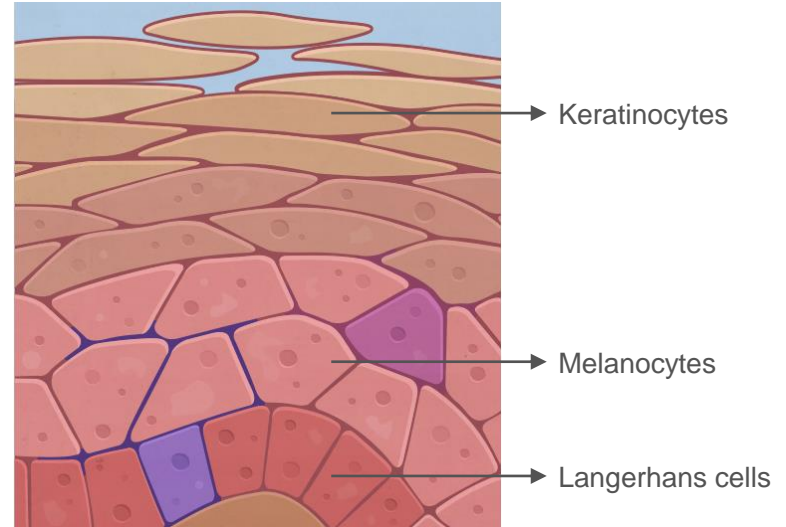


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# The cells of the epidermis

The epidermis, is composed of multi-layered epithelium. The cells of the epidermis are:

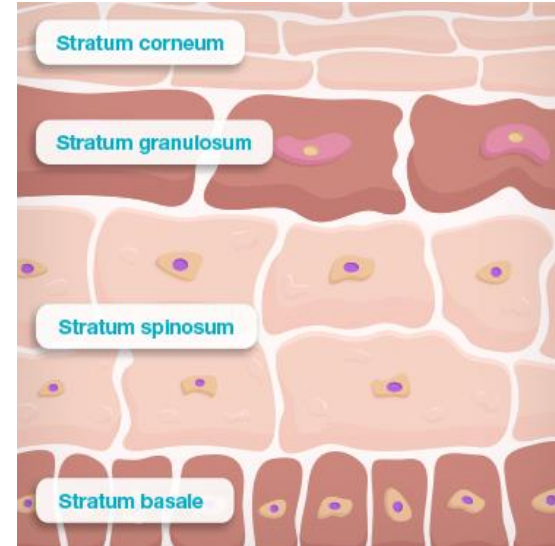
- **Keratinocytes** (95% of the cells) - maintain a 'water-proofing' effect to maintain the skin's barrier function.
- **Melanocytes** - responsible for skin pigmentation & protection against UV damage.
- **Langerhans cells** - part of the skin's immune system protecting against potential allergens, bacteria and toxic substances by triggering an immune response.



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# Keratinocyte differentiation

- Keratinocytes divide and migrate upwards through the stratum spinosum and the stratum granulosum which are living cells.
- As the keratinocytes migrate towards the surface they degenerate and die (now called corneocytes) producing the outer, stratum corneum layer, via the process of cell shedding (desquamation).
- As a result, the outermost layer is comprised of 20-30 rows of densely packed cells known as the stratum corneum which is keratinized.
- This means the skin is protected with a water-proof effect to withstand the external environment.



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# Epidermal cell turnover

- The stratum corneum is constantly being renewed, as dead epidermal cells are continuously shed.
- In normal skin, it takes 4 – 6 weeks for the epidermal cells to differentiate (from stratum basale to desquamation).
- The stratum corneum is renewed about every 2-3 weeks for individuals with normal skin.
- In skin diseases like psoriasis, the epidermal turnover time is quicker (forming characteristic reddish purple plaques) and can be as short as one week.

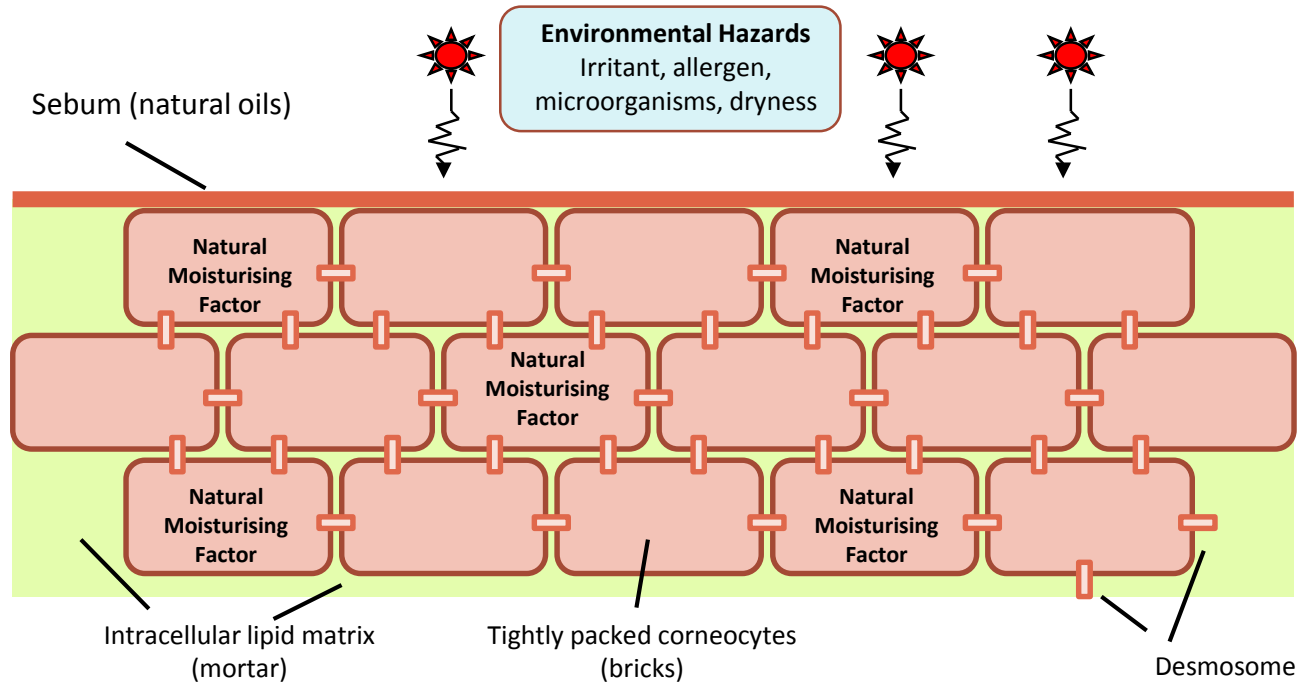


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**Reference:**

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# Healthy epidermal barrier “Bricks & Mortar” Model

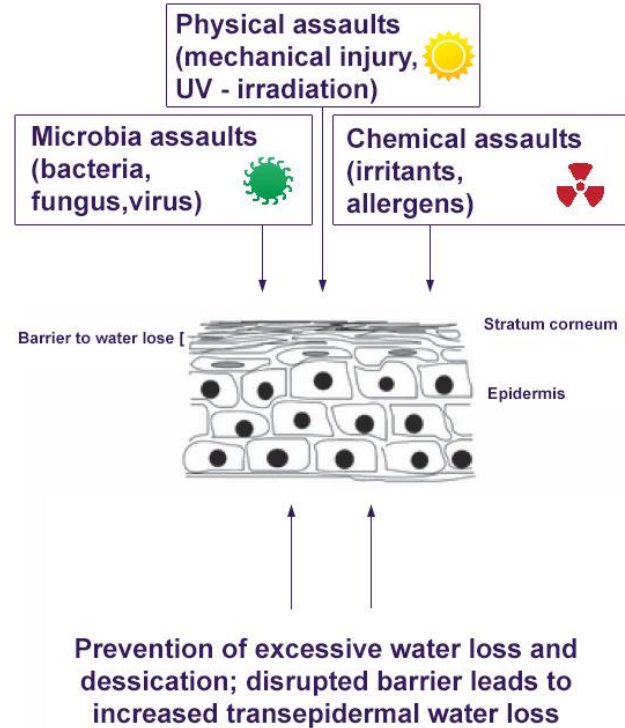


**Reference:**

Langøen, A. and Bianchi, J. (2013). Chapter 2: Maintaining Skin Integrity. In M. Flanagan (Ed.), *Wound Healing and Skin Integrity. Principles and Practice* (pp. 18-32). West Sussex: John Wiley & Sons, Ltd.

# Skin barrier function

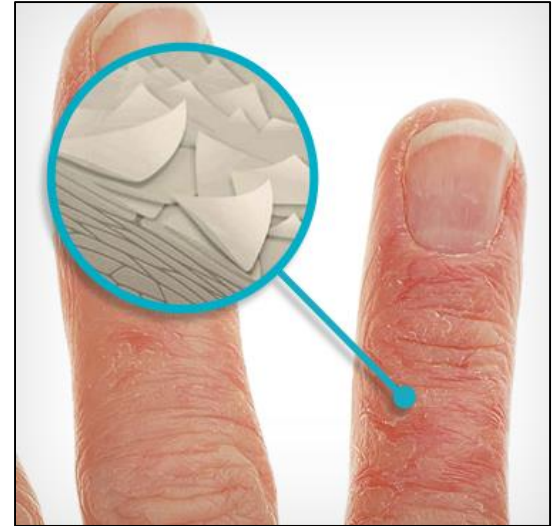
- The epidermal barrier is a highly specialised, structure that adapts to environmental conditions.
- It provides a physical and chemical barrier to block entry of foreign substances and triggers an immunological response against any pathogens that penetrate the barrier.



**Reference:**

# What happens when the skin becomes too dry?

- When the skin is dry, the keratin cells become flat and scaly. The skin feels rough and flaking may be visible.
- Dry skin often itches, causing the person to scratch, which may damage the protective barrier of the skin.
- When skin is dry, the function of the acid mantle is reduced resulting in reduced protection against bacteria. This, together with minor trauma from scratching, increases the risk of skin infection.



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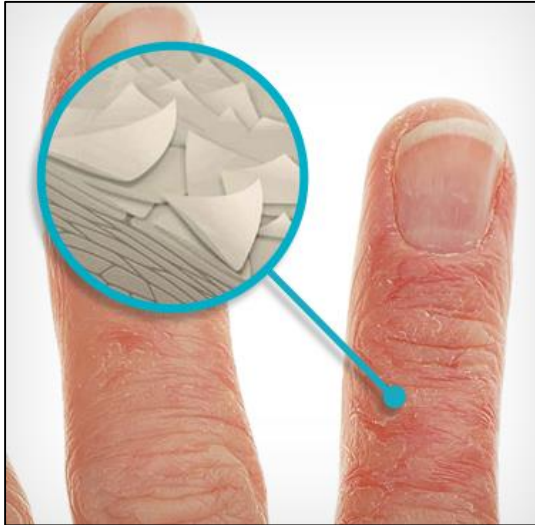
# Causes of dry skin



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- Co-morbidities, such as hypothyroidism, diabetes and autonomic neuropathy
- Inflammatory skin conditions, such as psoriasis and eczema
- Ageing
- Hormonal changes, such as menopause
- Environmental conditions, such as extreme cold, sun exposure and air conditioning
- Inappropriate skin hygiene, and
- Certain medications, such as diuretics

# Extremely dry skin

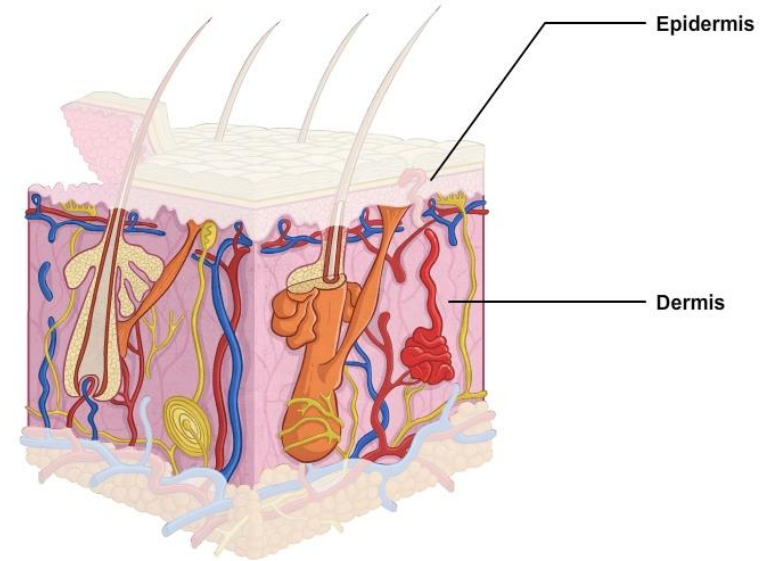


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- If evaporation at the epidermal surface is too high or secretion of natural lipids is too low, the skin will become dry, flaky and uncomfortable.
- Any break in the skin however small will affect skin barrier function.
- If the skin becomes extremely dry, the epidermis cracks and fissures.

# The dermis

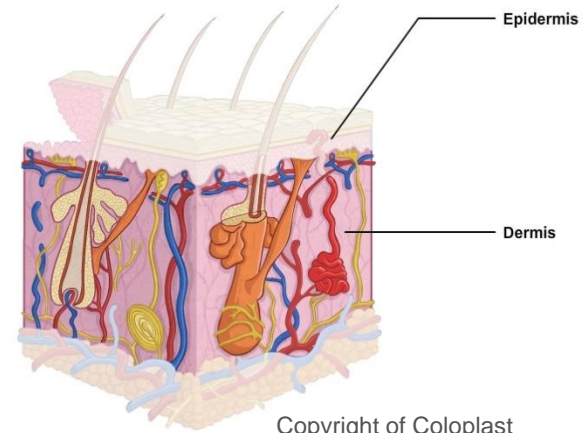
- Is the mid layer of the skin, consisting of connective tissue (mainly collagen and elastin fibers), and a semi-fluid substance consisting of polysaccharides, proteins, enzymes and metabolites.
- The dermis contains nerve endings, blood vessels, muscles and the skin appendages e.g. hair follicles, sebaceous glands and sweat glands.



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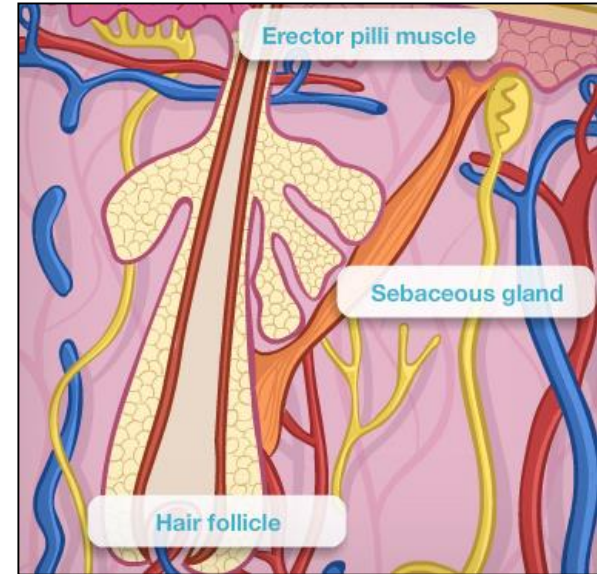
# Functions of the dermis

- The dermis provides nutrition to the epidermis.
- Regulation of the body temperature.
- Strength and support.
- Elasticity.
- Synthesize and secrete proteins  
e.g. extra cellular matrix formation.



# Sebaceous glands

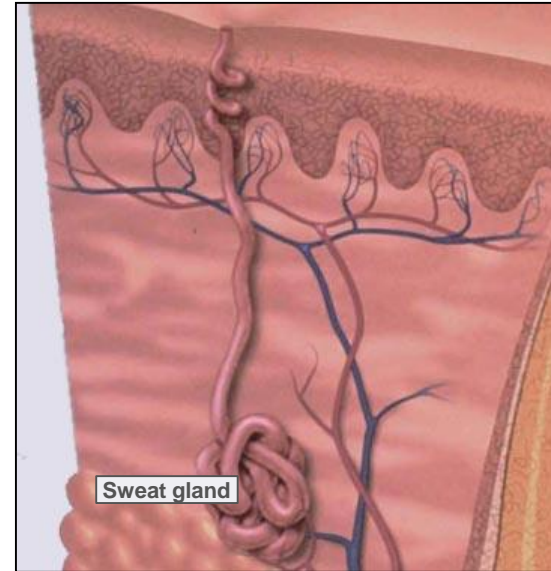
- Are found around hair follicles and secrete sebum, a lipid rich, oily substance which is important for the moisture content of the epidermis and the pH of the skin.
- Sebum is acidic and contains lipids, which combine with extracellular lipids to form a hydrophobic matrix that waterproofs the epidermis and prevents skin dehydration.



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# Acid Mantle

- Sebum and sweat create an acidic environment on the skin surface in the pH range of 4.5 to 5.5 referred to as the acid mantle.
- Sweat consists of water, sodium chloride, urea, and lactate and is needed to maintain the acid mantle.
- The acid mantle is antimicrobial reducing potential for pathogen invasion by controlling resident flora as bacteria multiply in a slightly alkaline (pH > 7) environment.



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# Sensation

- The skin is a sensory organ, collecting information via sensory bodies and nerve-endings.
- These provide information on touch, pressure, pain, vibration, and temperature.
- The location of sensory nerve endings in the dermis explains why superficial wounds are often more painful than those with more tissue loss.



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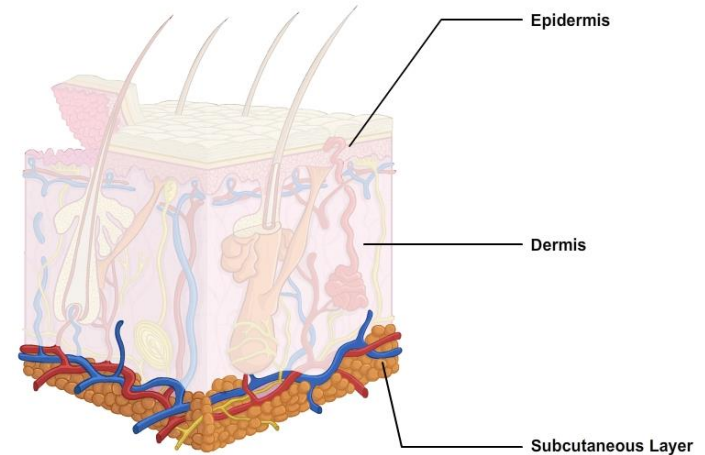


# Subcutaneous tissue

The subcutaneous tissue (subcutis) is composed of connective tissue and fatty tissue. It contains major vessels.

Functions of the subcutis include:

- Insulation
- Cushions and protects against mechanical injury



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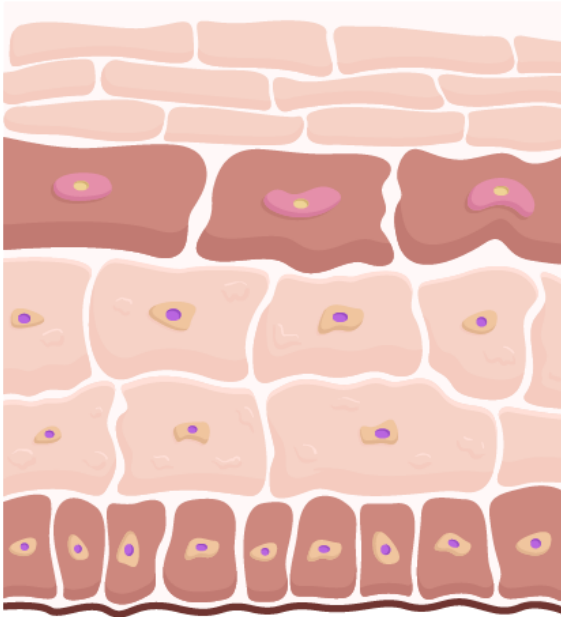


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# Let's test your understanding

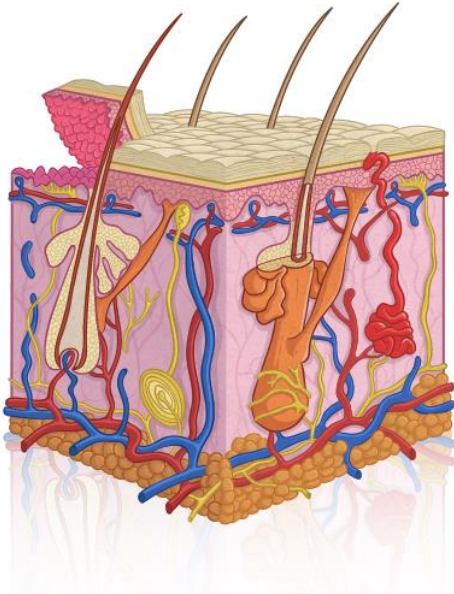
## Quiz no. 1



What is the name given to the layer of dead keratinocyte cells in the epidermis?

- a) Stratum corneum
- b) Stratum granulosum
- c) Stratum spinosum
- d) Stratum basale

## Quiz no. 2



What layer of the skin contains nerve endings, blood vessels, muscles and skin appendages?

- a) The epidermis
- b) The dermis
- c) The subcutaneous fat layer

# Factors affecting skin barrier function

- Age
- pH
- Moisture
- Humidity
- Irritants

# Age related skin barrier function - Neonates

Neonates have fragile, thinner, more immature skin than full term babies due to:

- Higher Trans Epidermal Water Loss
- Thickness of stratum corneum



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**Reference:**

Langøen, A. and Bianchi, J. (2013). Chapter 2: Maintaining Skin Integrity. In M. Flanagan (Ed.), *Wound Healing and Skin Integrity. Principles and Practice* (pp. 18-32). West Sussex: John Wiley & Sons, Ltd.

# Age related skin barrier function – Elderly skin

Elderly skin has:

- Decreased number of sebaceous glands
- Reduced number of sensory bodies
- Flattening of Rete Ridges

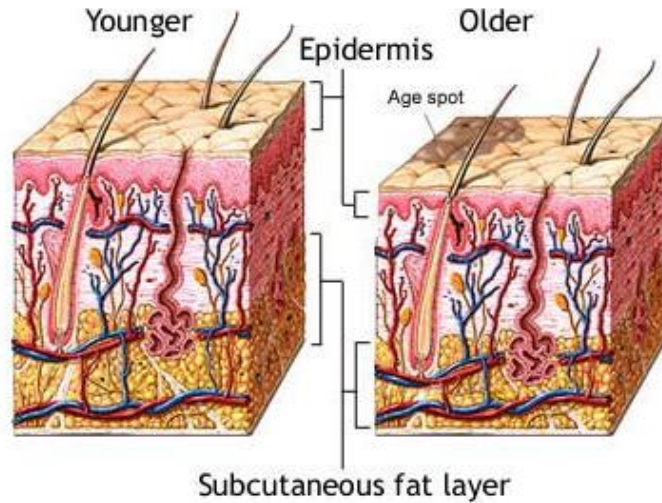


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**Reference:**

Raschke, C. and Elsner, P. (2010). Chapter 5: Skin Aging: A Brief Summary of Characteristic Changes. In M. A. Farage, K. W. Miller and H. I. Maibach (Eds.), *Textbook of Aging Skin* (pp. 37-43). Berlin: Springer Berlin Heidelberg.

# The effect of ageing on the skin



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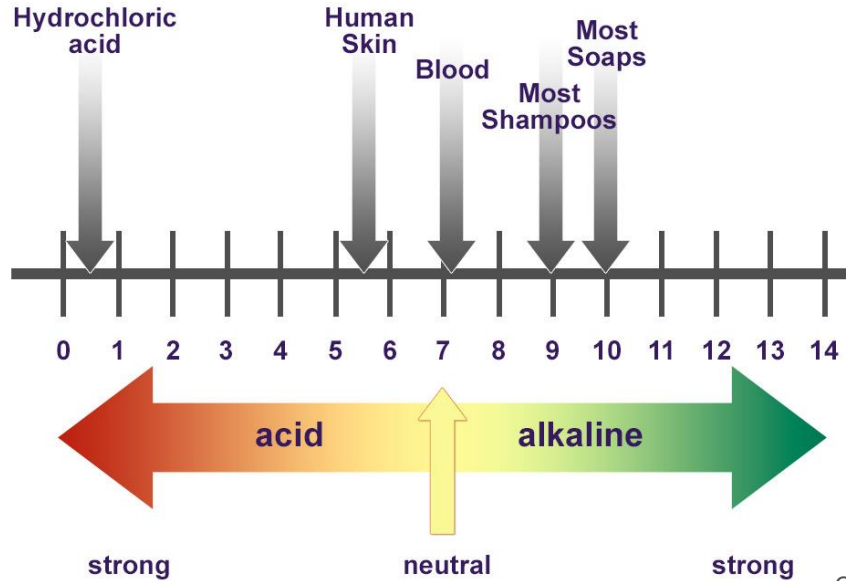
# Factors affecting skin barrier function

- Age
- pH
- Moisture
- Humidity
- Irritants



# The effects of pH on skin barrier function

If the pH value of the skin is changed, skin breakdown is more likely to occur.

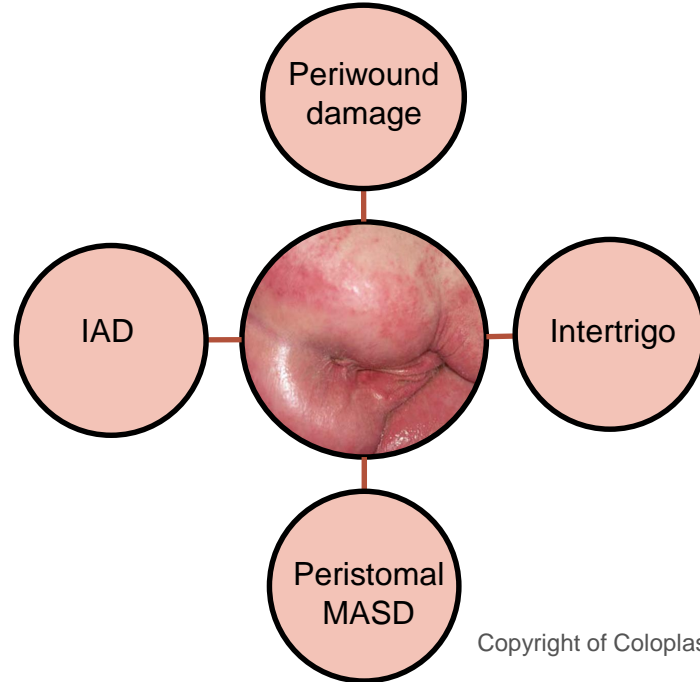


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# Factors affecting skin barrier function

- Age
- pH
- Moisture
- Humidity
- Irritants

# Moisture Associated Skin Damage (MASD)

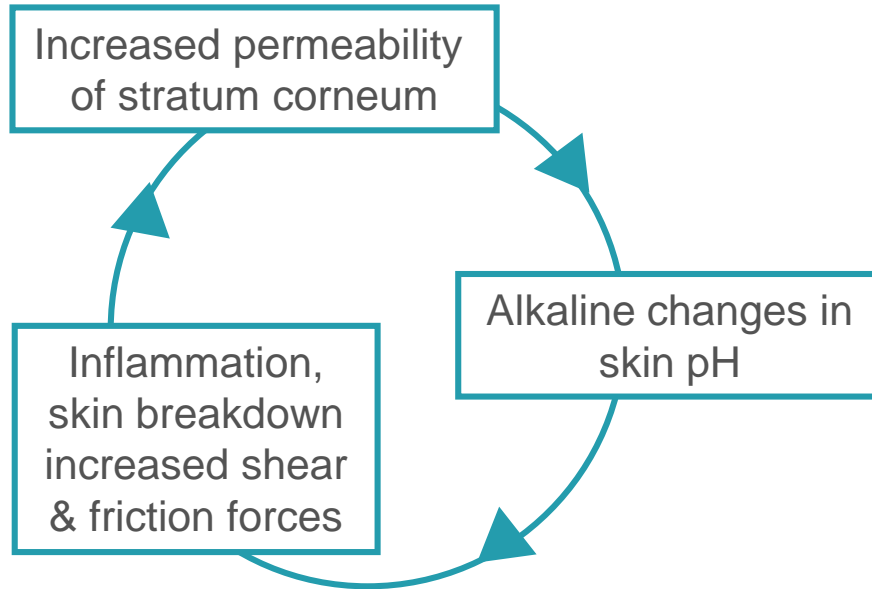


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**Reference:**

Voegeli, D. (2012). Moisture-associated skin damage: aetiology, prevention and treatment. *British Journal of Nursing*, 21(9), 517-521.

# The effect of moisture on skin barrier function



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**Reference:**

Voegeli, D. (2012). Moisture-associated skin damage: aetiology, prevention and treatment. *British Journal of Nursing*, 21(9), 517-521.

# Effects of chronic wound fluid on skin barrier function:

- High protease content in chronic wound fluid causes maceration & breaks down the Stratum corneum disrupting barrier function.
- This causes a prolonged inflammatory response in damaged skin releasing pro-inflammatory cytokines into wound fluid causing additional damage.
- Failure to deal adequately with exudate can lead to exposure of the periwound skin to exudate resulting in maceration of the surrounding skin.



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**Reference:**

White, R. J. and Cutting, K. F. (2003). Interventions to avoid maceration of the skin and wound bed. *British Journal of Nursing*, 12(20), 1186-1201.

# Effects of wound exudate on peri-ulcer skin

If exudate is not properly managed the peri-ulcer skin may become macerated.

- Excess moisture causes cells to swell which further damages the skin barrier function.
- The tissue at the wound edge may become non viable and impair epithelial migration.
- Wound healing is delayed.



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# Moisture balance is imperative to wound healing

Therefore it is important that excess exudate is removed from the wound by an absorbent dressing.

A wound dressing with good absorption and ability to contain exudate under pressure – could help prevent this damage.



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# Factors affecting skin barrier function

- Age
- pH
- Moisture
- Humidity
- Irritants



# The effects of humidity on skin barrier function

- Skin exposed to humid conditions such as conditions occurring between the skin folds under the breast, in the groin, in between the toe webs or under occlusive wound dressings.
- Skin will start to feel sore and may gradually turn white.



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**Reference:**

Voegeli, D. (2012). Moisture-associated skin damage: aetiology, prevention and treatment. *British Journal of Nursing*, 21(9), 517-521.

# Factors affecting skin barrier function

- Age
- pH
- Moisture
- Humidity
- Irritants

# The effect of irritants on skin barrier function

- Peristomal skin damage occurs when skin is exposed to effluent from an ostomy, resulting in inflammation and erosion.
- Lipases & proteases: produced by faecal bacteria break down protein in keratinocytes, contributing to skin breakdown.
- Faecal irritant reactions are more common around ileostomies as their effluent is strongly alkaline & contains unabsorbed waste products that break down skin proteins.



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**Reference:**

Black, J. M., Gray, M., Bliss, D. Z., Kennedy-Evans, K. L., Logan, S., Baharestani, M. M., Colwel, J. C., Goldberg, M. and Ratliff, C. R. (2011). MASD Part 2: Incontinence-Associated Dermatitis and Intertriginous Dermatitis. *Journal of Wound Ostomy & Continence Nursing*, 38(4), 359-370.

# The effects of irritants on skin barrier function

- The development of Incontinence Associated Dermatitis (IAD) is a complex mechanism that is not fully understood but involves an interaction between, urine and faeces on the skin, humidity, mechanical irritants and frequent use of soap and water.
- Environmental humidity in combination with use of detergents or leaving the skin damp will gradually break down the epidermal mechanical protective barrier.



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**Reference:**

Langøen, A. and Bianchi, J. (2013). Chapter 2: Maintaining Skin Integrity. In M. Flanagan (Ed.), *Wound Healing and Skin Integrity. Principles and Practice* (pp. 18-32). West Sussex: John Wiley & Sons, Ltd.

# The effects of irritants on skin barrier function

## Urine

- Water: decreases tissue tolerance, renders skin more susceptible to friction and erosion.
- Ammonia: raises pH, disrupts acid mantle, alters normal skin flora, increases bio burden, activates faecal enzymes.

When urine and stool mix, bacteria in stool converts urea to ammonia which initiates release of inflammatory cytokines and histamines.

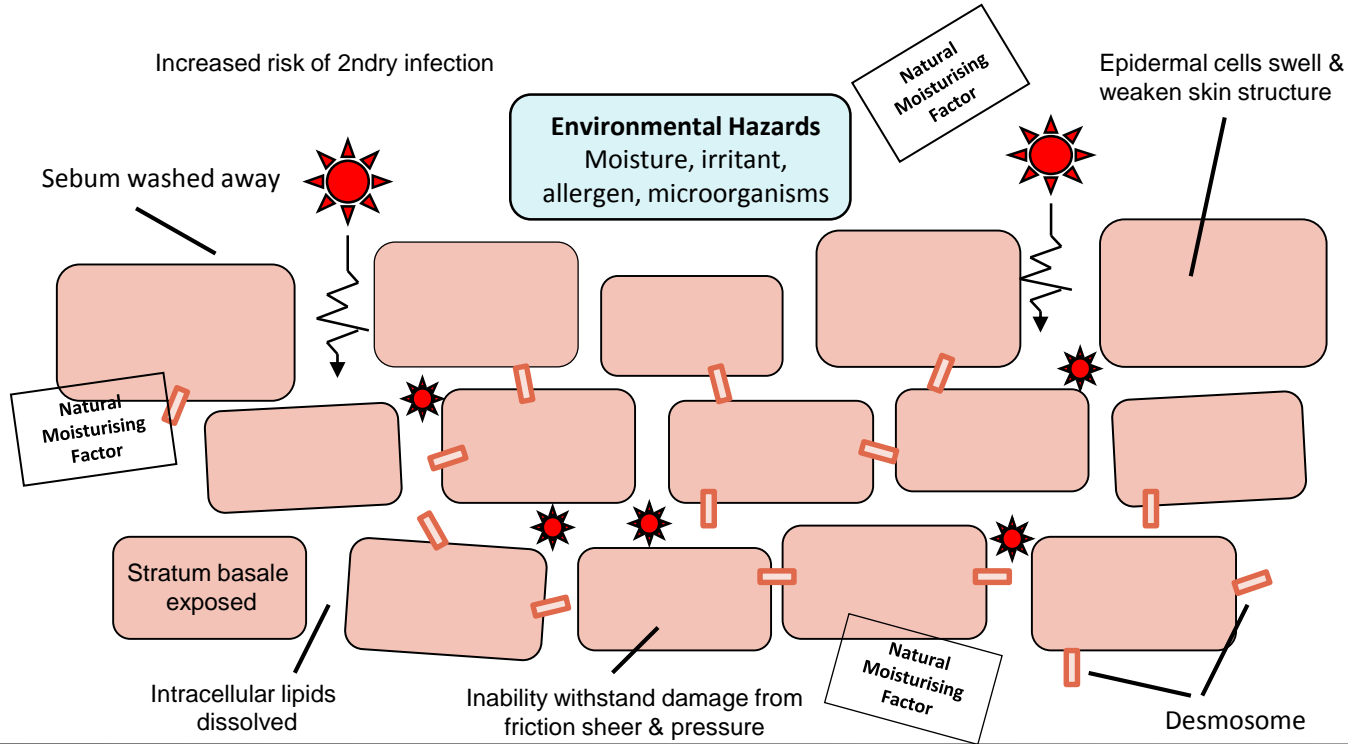


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**Reference:**

Ersser, S. J., Gettigge, K., Voegeli, D. and Regan, S. (2005). A critical review of the inter-relationship between skin vulnerability and urinary incontinence and related nursing intervention. *International Journal of Nursing Studies*, 42, 823-835.

# Summary: damaged epidermal barrier

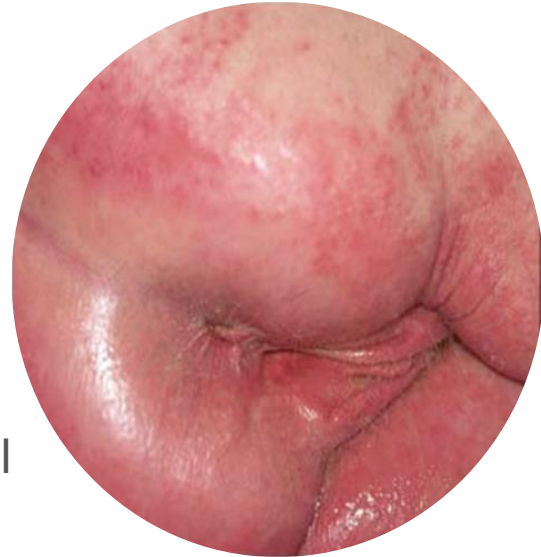


**Reference:**

# Diagnosing the cause of skin barrier damage

In the sacral area, even experts have difficulty identifying if skin damage is due to pressure damage or moisture damage.

The differences can be difficult to see in clinical practice but are summarized on the next slide.



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**Reference:**

Mahoney, M., Rozenboom, B., Doughty, D. and Smith, H. (2011). Issues Related to Accurate Classification of Buttocks Wounds. *Journal of Wound Ostomy & Continence Nursing*, 38(6), 635-642.

	MASD	Pressure Ulcers
Causation	Moisture, irritation	Pressure, friction, shear, ischemia
Location	Skin folds e.g. natal cleft, breast, perineum, sacrum, peri-anal area, inner thighs, toe webs	Bony prominences, areas of high pressure e.g. medical devices
Wound shape	Linear in skin folds, more diffuse depending on exposure	Round / oval ulceration
Wound depth	Superficial/partial thickness	Full thickness wounds, undermining, sinus.
Wound margin	Diffuse	Well demarcated
Treatment objective	Keep skin, clean, dry & well hydrated	Reduce / relieve pressure , friction & shear

**References:**

Beeckman, D., Schoonhoven, L., Fletcher, J., Furtado, K., Gunningberg, L., Heyman, H., Lindholm, C., Paquay, L., Verdú, J. and Defloor, T. (2007). EPUAP classification system for pressure ulcers: European reliability study. *Journal of Advanced Nursing*, 60(6), 682-691.

Defloor, T., Schoonhoven, L., Weststrate, J. and Myny, D. (2006). Reliability of the European Pressure Ulcer Advisory Panel classification system. *Journal of Advanced Nursing* 54(2). 189-198.





# Differential diagnosis to IAD

Determine location of skin damage:

- Skin fold
- Underneath containment device
- Over bony prominence

Inspect the skin for:

- Erythema
- Swelling
- Cracking
- Vesicles



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**Reference:**

Voegeli, D. (2012). Moisture-associated skin damage: aetiology, prevention and treatment. *British Journal of Nursing*, 21(9), 517-521.

# Summary of Maintaining Healthy Skin Integrity

- The most important function of the skin is to provide a semi permeable barrier to protect the body from the outside world.
- Many interrelated factors contribute to failure of skin barrier function and skin breakdown.
- It is important to understand these factors to preserve and restore skin barrier function in everyday clinical practice.
- Skin breakdown is largely preventable.



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# References

- Beeckman, D., Schoonhoven, L., Fletcher, J., Furtado, K., Gunningberg, L., Heyman, H., Lindholm, C., Paquay, L., Verdú, J. and Defloor, T. (2007). EPUAP classification system for pressure ulcers: European reliability study. *Journal of Advanced Nursing*, 60(6), 682-691.
- Black, J. M., Gray, M., Bliss, D. Z., Kennedy-Evans, K. L., Logan, S., Baharestani, M. M., Colwel, J. C., Goldberg, M. and Ratliff, C. R. (2011). MASD Part 2: Incontinence-Associated Dermatitis and Intertriginous Dermatitis. *Journal of Wound Ostomy & Continence Nursing*, 38(4), 359-370.
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