

Not Too S-keen!

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Adapted from: The Science of Skin by TBD (with rizz)'s Final Lesson Fa22

Field(s) of Interest: Dermatology, Skin anatomy, Cancer

Brief Overview (1-3 sentences):

In this lesson the mentees are going to learn about the different layers of the skin, its functions, and the fact that skin is an integral organ (and the largest!) of the human body. This lesson also aims to share the importance of sunblock, the range of UV rays that may cause sunburn to cancer, and finally introduce the idea of carcinogenesis.

Agenda:

- Introduction (5 min)
- Module 1: I (der)Mis you!! (10-15 min)
- Module 2: Unfriended, SUNBLOCKED, my mom's calling your mom and you're not invited to my sweet 16 birthday bash (10-15 min)
- Module 3: Are U a Mutation? Cause Now My ATGC Is UUUU (10-15 min)
- Conclusion (5 min)

<p>Main Teaching Goals/Key Terms:</p> <ul style="list-style-type: none"> → Integumentary System → Epidermis → Dermis → Hypodermis / subcutaneous tissue → Chromophores → UVA (ultraviolet A) + UVB (ultraviolet B) → SPF (sunburn protection factor) → Carcinogenesis → DNA → Mutation 	<p>Mentor Development Goals: *Written by MD*</p> <ul style="list-style-type: none"> → BIG words: lets make it simple → Connecting to bigger picture → Listen and tell
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Introduction

As the body's largest organ, skin protects against germs, regulates body temperature, and enables tactile sensations. It is the first layer of defense against disease and infection, yet the importance of skin health is often overlooked.

Concepts to Introduce <ul style="list-style-type: none">• The suffix -dermis is a term related to dermatology (can help the kids remember the layers).• Cancer can be caused by anything. In this case it is UV rays.• Mentees could be curious about how our skin holds us together. Mentors can explain their understanding.<ul style="list-style-type: none">◦ Can explain about the role of collagen, though this is more towards dermatology rather than skin anatomy.• What you eat can affect your skin conditions (e.g. eating more peanuts might cause acne). Find out more here: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2836431/	Questions to Pique Interest <ul style="list-style-type: none">• How does our skin compare to animals (e.g. fish scales, whale body, feathers, dog fur, etc)?• What is the main purpose of having skin?• How has skin anatomy changed over time due to evolution? Was it thicker? Were there extra layers?• How do people get cancer? How do we prevent it?
Scientists, Current and Past Events <ul style="list-style-type: none">• Skin cancer is currently the most common cancer in the US, according to the CDC.• Eczema is a common skin allergy among children.• Cancer treatment is always undergoing development! Here are recent research on cancer treatments: https://www.cancer.gov/about-cancer/treatment/research• 	Careers and Applications <ul style="list-style-type: none">• Dermatologist<ul style="list-style-type: none">◦ Identifies skin diseases and treats them◦ Can help patients form a skin care routine for skin maintenance.• Cosmetologist<ul style="list-style-type: none">◦ Works at medical or luxury spas◦ Specializes in treatments for facial and body skin• Research and Development<ul style="list-style-type: none">◦ Create and test formulas for skin products

Background for Mentors

Module 1

- Integumentary System
- Epidermis
- Dermis
- Hypodermis / subcutaneous tissue

The skin is part of the **integumentary system**, which is the outermost layer of the human body. This means it contains the skin, nails, hair, and glands. The integumentary system functions as a physical barrier against the environment. For example, it protects your body from infection, injury, and sunlight (which we will be learning a lot in this lesson!). Additionally, it also maintains body temperature.

Diving deeper, the human skin is made out of three main layers. The outermost layer is called the **epidermis**. This layer is the one we can see and touch. It functions as the first line of defense against the external environment, it helps your body stay hydrated, and it produces new skin cells. Additionally, it also helps reduce the harmful effects of UV radiation before it pierces into deeper layers. Fun fact: it is waterproof!

The layer below the epidermis is called the **dermis**. It is the sandwiched layer of the skin and it is the thickest as well. It contains sweat, oil glands, hair follicles, blood vessels, as well as collagen and nerve endings. The function of the dermis is to help maintain body temperature and aid in sensation. The dermis basically holds the body together like a stocking.

Finally, the innermost layer is called the **hypodermis**, also known as the **subcutaneous tissue**. It has many important functions such as storing energy, connecting the dermis layer to the muscle and bone, and insulation. It is primarily made up of fatty tissue, hence the insulative property.

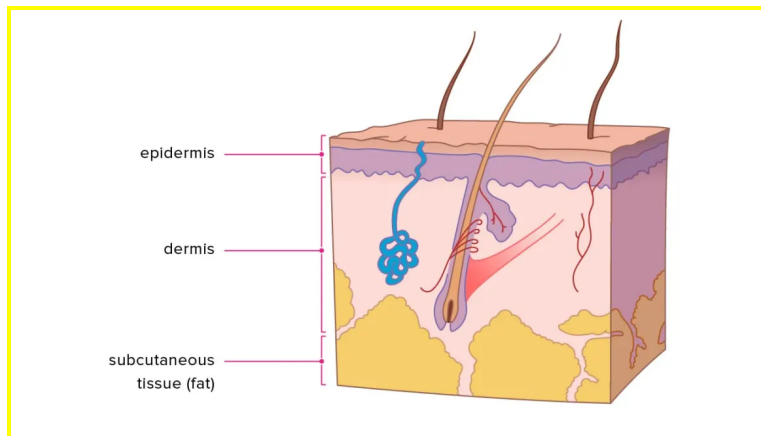


Figure 1: The three main layers of skin are the epidermis, dermis, and hypodermis/subcutaneous tissue

Background for Mentors

Module 2

- UVA
- UVB
- Chromophores
- SPF

Even though the skin may have many layers, it is not immune. One of the main sources of damage towards the skin actually comes from the sun, something that we are all exposed to almost everyday. How exactly does the sun damage our skin?

First, we will have to delve into the science behind what the sun emits. You might simply think that the sun emits light in the form of rays, which is not wrong! The sun actually emits specific rays: **UVA** and **UVB**, which are not the same due to its different wavelengths. UVB (ultraviolet B) usually only damages the outer layer of our skin, which simply causes our skin to burn and. On the other hand, UVA (ultraviolet A) rays would damage even the epidermis and dermis layers, going even deeper into the skin's layers.

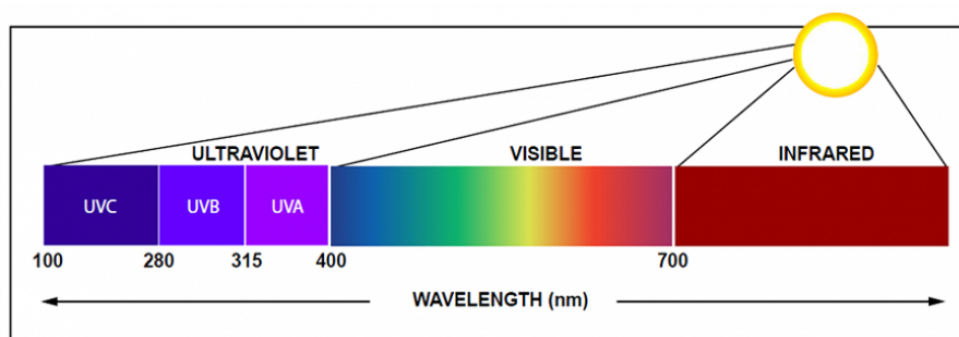


Figure 2: The wavelength

They are also less understood but have a correlation with our tanning response, carcinogenesis (which we will cover in the next module!), and aging. These two wavelengths exert different effects on the skin due to the absorption patterns of **chromophores**, which is a molecule responsible for its own color. There are several types of chromophores but the two main ones are: **hemoglobin** and **melanin**. Hemoglobin is found in our red blood cells and melanin is what gives our skin its pigment.

There are two basic types of sunscreen: **physical blockers** and **chemical absorbers**. Physical blockers, such as zinc oxide and titanium dioxide, essentially act like a physical barrier between the UV rays and your skin. Chemical absorbers, on the other hand, absorb these sun rays. However a downside to it is that it deteriorates quickly as it constantly absorbs the rays.

Both types of sunscreens need to go through some testing to determine the sunburn protection factor (**SPF**). This essentially measures the level of

protection the sunscreen has against UVB rays before an individual starts to burn.

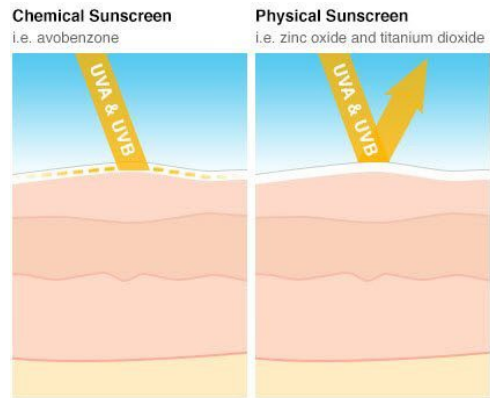


Figure 3: How physical blockers and chemical blockers work

Background for Mentors

Module 3

- Carcinogenesis
- DNA
- Mutation

Carcinogenesis is the process of how our normal body cells become cancerous cells. **Cell division** is a normal process that each cell undergoes to produce more cells and keep your body functioning. However, when cell division gets out of control (continuously divides despite needing to stop), it may result in several health issues such as tumors.

Normally, after cell division, our cells are programmed to apoptosis, which is where the cell destroys itself. This helps maintain a healthy amount of cells in the body. Cancer cells typically skip this step, hence a build up of unwanted cells.

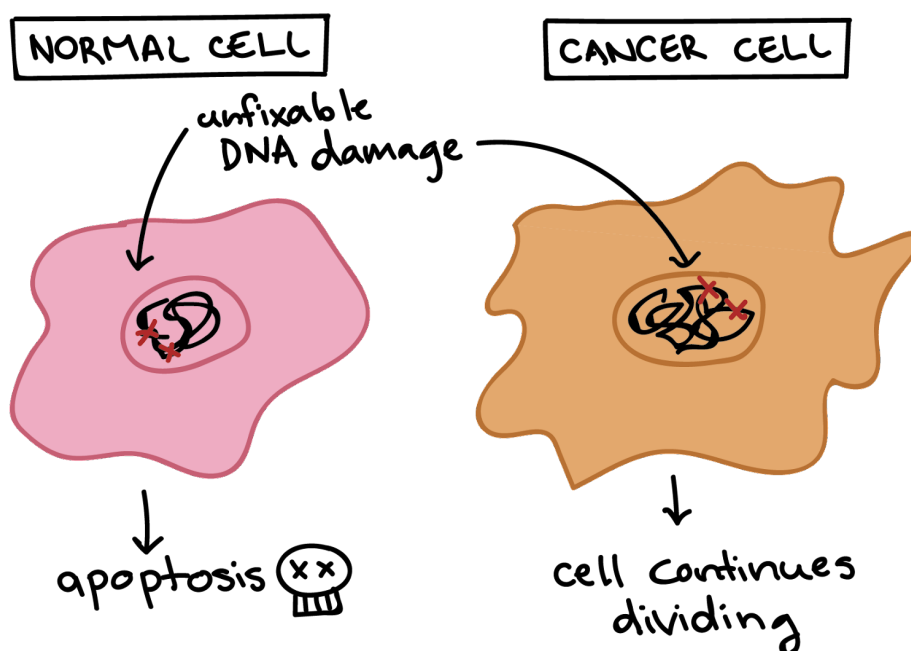
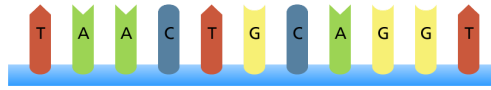


Figure 4: Normal cell vs Cancer Cell

DNA molecules are polymers made up of a phosphate backbone and DNA base pairs. The sequence of DNA is what makes up our genetic code and what makes us express certain characteristics. There are around 3 billion base pairs on each DNA strand so you can imagine how incredible the systems that make these are. Unfortunately with such high amounts of base pairs there is bound to be some errors which are called **mutations**. These mutations can lead to different character traits unrelated to our parents or even cancerous cells.

Original sequence



Point mutation

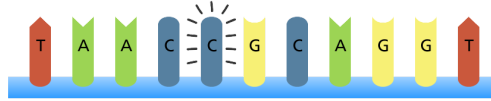


Figure 5: Base mutation

Too much UV radiation from the sun damages the DNA in skin cells, increasing cancer risk.

Module 1: I (der)Mis you!!

Mentees will be learning about the 3 important layers of the skin and will build a 3D model of the skin layer.

Teaching Goals <ol style="list-style-type: none">1. Integumentary system: the outer layer of the human body. Includes skin, nails and hair.2. Epidermis: outermost layer of skin.3. Dermis: middle layer of skin. The thickest layer (contains glands and hair follicles).4. Hypodermis / subcutaneous tissue: Innermost layer of skin. Contains fatty tissue that insulates the body. <hr/> MD Goals <p>BIG words: lets make it simple. For definitions especially with big words like the goals of these lessons we suggest using many analogies or maybe other synonyms for these words to help the mentees learn. Another thing that might be useful is explaining the term and then asking if the class can explain it back to you right after.</p>	Materials <ul style="list-style-type: none">● yellow playdough (hypodermis)● soft dish sponge (dermis)● construction paper (epidermis).● 1-inch pieces of pipe cleaners (skin hairs)● Elmer's Glue
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Procedure

1. Cut a single dish sponge into 6 equal pieces.
2. Flatten the playdough into a thin layer to make the hypodermis. Make sure the perimeter is the same as the tiny dish sponge pieces.
3. Place the soft dish sponge on top of the playdough to represent the dermis.
4. Make use to glue the two components together.
5. Place a rectangular piece of construction on top of the dish sponge to represent the epidermis. Make sure the perimeter is also the same as the tiny dish sponge piece.
6. Glue the two components as well.
7. **Optional:** Insert short pieces of pipe cleaners through the construction paper into the sponge to represent skin hairs.
- 8.

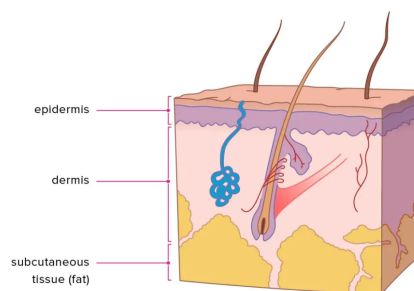


Figure X: Diagram of the three main layers of skin

Module 2: Unfriended, **SUNBLOCKED**, my mom's calling your mom and you're not invited to my sweet 16 birthday bash

Using the 3D model from module 1, mentees will pair up and apply sunblock on one skin model and moisturizer on the other. Both mentees will shine UV light on top of both models to visualize the difference sunblock does for the skin.

Teaching Goals <ol style="list-style-type: none">1. Chromophores: Molecules that give themselves a color.2. UVA: Sun rays that may cause aging and carcinogenesis, and responsible for our tanning response.3. UVB: Sun rays that only damage the outer layer of your skin.4. SPF: Measures the level of protection the sunscreen has against UVB rays before an individual starts to burn. <hr/> MD Goals	Materials <ul style="list-style-type: none">• 1 ml moisturizer• 1 ml sunscreen• UV light• Worksheet
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Procedure

1. Distribute worksheets to mentees.
2. Help mentees apply a reasonable layer of moisturizer onto the box on the worksheet under "moisturizer".
3. Help mentees apply a reasonable layer of sunscreen onto the box on the worksheet under "sunscreen".
4. Turn off the lights in the room to make it dark.
5. Have each mentor go around the room to shine the UV light on the skin model to groups of mentees and explain the science behind it.
6. Mentees should see that the sunblocked construction paper is dark under UV light while the one with moisturizer is not. This is because sunblock is supposed to block out UV rays.

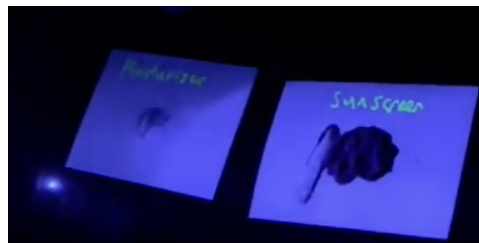


Figure X: Moisturizer (left) vs. sunscreen (right) under UV light

Classroom Notes

Make sure mentees can see the difference between sunscreen and moisturizer.

Module 3: Are U a Mutation? Cause Now My ATGC Is UUUU

Without really focusing on cancer, mentees could understand the idea of cancer through a simple telephone game. This game focuses on the idea that one wrong mutation can create a ripple of more mutations, hence causing cancer.

Teaching Goals

1. **Carcinogenesis:** process of how our normal body cells become cancerous cells.
2. **DNA:** polymers made up of a phosphate backbone and DNA base pairs.
3. **Mutation:** base pairs with errors.

MD Goals

Connecting to bigger picture: This module isn't very activity heavy so trying to find ways to help the students connect to bigger picture and learn more about these topics more in depth would be helpful.

Listen and tell: since this will involve a lot of the mentees speaking it might get a bit chaotic with all mentees wanting to talk. This is a great way to practice having mentees raise their hands or try to not just yell things out.

Materials

- Just ourselves
- A list of sequences of numbers or letters (can be on phone - or come up with it on the spot)

Procedure

1. Gather mentees in a circle on the floor.
Mentors may sit together with them on the floor.
2. Explain how the telephone game works:
 - a. One person starts with a random sequence
 - i. E.g. AIFNRBGJFH
 - ii. E.g. 1946395639430
 - b. Whisper the sequence **only once** to the person on your left
 - c. Make sure no one repeats the sequence when they whisper
 - d. If they can't make out the sequence let them just say what they think the sequence is.
 - e. **Twist:** to recreate a UV ray breaking, ask one of the mentees to yell every so



Figure X: People sit in a circle and whisper into each other's ears

- often (per round) to disrupt the chain.
- f. Let the word get passed around until it reaches the last person around the circle.

Classroom Notes

Mentees should yell at random times. The mentee yelling can't be the same mentee who needs to pass on the sequence. Give different mentees a chance to yell. Make sure the yelling doesn't go out of hand. If your site is chaotic, maybe don't do the twist.

Conclusion

Ask mentees to reflect on the lesson today, reviewing the three layers of the skin and what happens to the skin when it undergoes exposure to UV rays.

References

- Add references in case your mentors want additional information!
- Title of Source, Author, Organization. <http://www.example.com/>

Summary Materials Table

Material	Amount per Site	Expected \$\$	Vendor (or online link)
Sponge	1 per student		Amazon
Sunblock			
Moisturizer			
Construction paper			