

# Skin Under the Microscope: NYSSLS Alignment

Teacher guide for the student worksheet at [mrsajdak.com/skin-layers](https://mrsajdak.com/skin-layers) (two pages, 20 questions; Day 1 on the front, Day 2 on the back; a low-write version has the same numbers). Anatomy & Physiology, Hole's Essentials 6.2: Layers of the Skin. Day 1: Layers of the Skin (AP.3.6.2), tabs 1 and 2. Day 2: Layers of the Epidermis and Dermis (AP.3.6.3), tabs 3 and 4.

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## Performance expectations: building toward

The lab and worksheet give students evidence for these performance expectations. They are one step on the way, not a full assessment of any one of them.

### HS-LS1-2

*“Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.”* Worksheet link: students work down the levels of one organ: the skin's layers (Q1), the strata inside the epidermis and the two layers of the dermis (Q11, Q16), and the cells in them (Q12, Q13), tying each level to the job it does (Q6, Q10, Q18).

### HS-LS1-3

(the plan book's tag) *“Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.”* Worksheet link, partial: students choose the right objective to measure each layer (Q3, Q4) and see the epidermis held at a steady thickness while cells are lost from the top and replaced from the bottom (Q12, Q15). The lab does not model a feedback loop itself.

### HS-LS1-1

(the plan book's tag) *“Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.”* Touched only: keratinocytes are specialized cells whose job ends in one protein, keratin, which fills the cell as it dies (Q13). DNA is not modeled.

DCI LS1.A: *“Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.” “Systems of specialized cells within organisms help them perform the essential functions of life.”*

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## Part by part

| Part                                            | Science and Engineering Practices                                                                                                             | Disciplinary Core Ideas                                 | Crosscutting Concepts                                      | What students do                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Day 1 • 1. Virtual microscope</b><br>Q1 to 6 | SEP 3 Planning and carrying out investigations<br>SEP 4 Analyzing and interpreting data<br>SEP 5 Using mathematics and computational thinking | LS1.A structure and function; hierarchical organization | Scale, Proportion, and Quantity;<br>Structure and Function | Focus the slide, identify the three layers on thin (forearm) and thick (palm) skin, and measure the epidermis and dermis with a 50-division eyepiece scale (50, 20, 5 $\mu\text{m}$ per division at 4 $\times$ , 10 $\times$ , 40 $\times$ ), choosing the objective that fits each layer and converting divisions to $\mu\text{m}$ and mm. Then send a scrape, a cut and a deep cut into each slide: the same 0.3 mm cut bleeds on the forearm and stays in the bloodless epidermis on the palm. |
| <b>Day 1 • 2. Body map</b><br>Q7 to 10          | SEP 4 Analyzing and interpreting data<br>SEP 5 Using mathematics and computational thinking                                                   | LS1.A structure and function                            | Patterns; Structure and Function                           | Compare epidermis and dermis at six sites drawn to the same scale, then re-sort by each layer. The epidermis is thickest where skin is rubbed (palm, fingertip, sole: thick skin); the dermis is thickest on the back, which is pulled but not rubbed.                                                                                                                                                                                                                                            |

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|---------------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Day 2 • 3.</b><br><b>Inside the epidermis</b><br>Q11 to 15 | SEP 2 Developing and using models<br>SEP 4 Analyzing and interpreting data              | LS1.A specialized cells      | Stability and Change; Structure and Function | Identify the five strata (lucidum in thick skin only), then follow one keratinocyte from the stratum basale to the day it flakes off (about 4 weeks in thin skin): it flattens, fills with keratin and dies in the granulosum. Overlays show melanocytes in the basale and food and oxygen diffusing up from dermal capillaries into the avascular epidermis.                                |
| <b>Day 2 • 4.</b><br><b>Inside the dermis</b><br>Q16 to 19    | SEP 3 Planning and carrying out investigations<br>SEP 4 Analyzing and interpreting data | LS1.A structure and function | Structure and Function                       | Find seven structures (papillary layer, dermal papilla, capillary loop, tactile corpuscle, reticular layer, sweat gland, lamellated corpuscle), with an elastic-fiber stain to switch on. Pull strips of papillary dermis, reticular dermis and tendon along and across: dense irregular tissue is strong both ways, dense regular tissue only one way. Count friction ridges in a 5 mm box. |
| <b>Wrap it up</b><br>Q20                                      | SEP 6 Constructing explanations<br>SEP 7 Engaging in argument from evidence             | LS1.A                        | Stability and Change                         | Claim, evidence and reasoning: tattoo ink lasts because it sits in the dermis, which stays, rather than the epidermis, which renews every few weeks.                                                                                                                                                                                                                                         |

## Using it with the lessons

- **Day 1 (Layers of the Skin):** tab 1 is the Explore (find, measure, injure); tab 2 is the Elaborate. Front of the worksheet only. The Day 1 lesson's follow-along sheet records the same measurements, so a class can use either sheet.
- **Day 2 (Layers of the Epidermis and Dermis):** tabs 3 and 4, back of the worksheet. Q20 closes the tattoo question the Day 1 lesson opens.
- **Not here on purpose:** hair, nails, glands and pigment are seen on the slides and named, but each has its own later lesson.

## Also in play

- **Key terms:** epidermis, dermis, subcutaneous layer (hypodermis), thick skin, thin skin, stratum basale, spinosum, granulosum, lucidum, corneum, keratinocyte, keratin, keratinization, melanocyte, avascular, papillary layer, reticular layer, dermal papilla, friction ridge, collagen, elastic fiber.
- **Real numbers, rounded:** epidermis about 0.05 mm (eyelid), 0.07 (forearm), 0.08 (back), 0.4 (palm), 0.5 (fingertip), 1.0 (heel); dermis about 0.4, 1.2, 3.0, 1.5, 1.2, 2.0 mm. Sources: Kolarsick et al. 2011 (epidermis 0.05 mm eyelid to 1.5 mm palm and sole), Lintzeri et al. 2022 meta-analysis (periorbital 53 µm, palm 183 µm, fingertip 520 µm, plantar foot 597 µm), and 50 MHz ultrasound in 74 adults (dermis: forearm 1.6 mm, back 2.9 mm). Keratinocyte trip: about 4 weeks (OpenStax A&P 2e: the stratum corneum is replaced in about 4 weeks; published estimates run to about 8 weeks and slow with age). Friction ridges about 0.5 mm apart.
- **Simplified on purpose:** 50-division eyepiece scale; thicknesses fixed at the scale line; one injury depth per button; pull-test forces are model values for a 10 mm by 0.5 mm strip that keep the real contrasts (reticular much stronger than papillary; dense irregular strong both ways, tendon one way). The page says so.

Standards text quoted from the New York State P-12 Science Learning Standards, High School Life Science (NYSED). The answer key is a separate file, kept off the public site.