



SKIN DEEP



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These ideas and activities are designed to promote the use of SOAR to investigate outer coverings. Although activities are identified for **HIGHER** (middle/high school) and **ELEMENTARY LEVELS**, they can easily be modified for any skill level.

OUTER COVERINGS

When you give it some thought, almost every outer covering--whether it's a cell membrane, an animal skin, the scales of a fish, the cuticle of a plant, a plastic grocery bag or your winter coat--all serve to contain, to protect, and to keep certain things in and certain things out. As we examine the outer coverings of various living organisms, we will see many similarities and differences. An outer covering with special features helps an organism live successfully in its particular environment.

Some Human Skin Facts:

- An average-size adult has about 70 square feet of skin that weighs about 9 pounds. (Map out an area on the floor that measures 7 feet x 10 feet and consider that the total weight of skin exceeds that of the average newborn baby).
- Most body skin is about 2mm thick, over the eyelids only 0.5mm thick, and on the soles of the feet, about 6mm thick.
- Skin is an organ composed of all four tissue types: epithelial, connective, nervous, and muscle tissues.
- Skin is constantly renewed due to mitosis (cell division) that results in new cells pushing up to the surface, dying, and then being sloughed off due to wear and tear (shed skin cells are called dander); this turnover process takes from 15 to 30 days.
- Skin is part of the integumentary system along with hair and nails.
- Hair and fingernails are dead structures; a fingernail grows 1 inch per year, 4 times faster than a toenail; a head hair usually grows for a few years and then falls out at the rate of about 50 hairs per day; mitosis continues for a short period after death which explains why hair and fingernails of the deceased may grow in length.
- There are at least 100,000 hairs on the head and about 5 million on the body with no hair on palms of hands and soles of feet; the hair grows from a follicle and only a few cells at the root of a hair are living.
- Hair color depends upon the amount of melanin pigment in the cells; white/gray hair has an absence of pigment; the shape of the hair follicle determines wavy, curly, and straight hair.
- Sweat glands are all over the skin; they would stretch for about 30 miles if laid end-to-end.

Reference: *Can You Believe It?*, J. Vaughan, 1990, Derrydale Books, New York

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What's Human Skin Good For?

- acts a barrier to protect against invaders (infection)
- produces oily sebum from sebaceous glands makes the skin waterproof
- traps air between the hairs to warm and insulate the body
- cools off the body by releasing sweat from sweat glands; sweat cools the skin when it dries
- makes vitamin D when exposed to sunlight
- enables us to respond to touch and to sense what is going on around the body

I. Human Skin Organization: (ALL LEVELS; simplify for Elementary)

After a look on the surface of skin it's time to ask students what they think is on the inside of skin.

Use skin model/prepared slide of the scalp (cross section) to observe the following:

- 3 major layers of skin: epidermis, dermis, hypodermis
- 4 tissues present in skin: epithelial, connective, nervous, muscle
- layers of epidermis: stratum corneum, lucidum, granulosum, spinosum, basal (germinativum)
- hair within hair follicle, hair shaft and hair root
- sebaceous gland associated with hair follicle
- arrector muscle of hair follicle
- sweat gland and sweat gland duct that opens to the surface
- blood vessels
- fat cells
- collagen and other fibers
- sensory receptors: Meissner's corpuscles and Pacinian corpuscles

II. Connect Human Skin Terms to Other Terms: (HIGHER LEVELS)

Study the following list of words and discuss how the knowledge of prefixes and root words helps in mastering difficult scientific terms:

Epidermis- epi-over, upon

Dermis-derm-skin

Sub-below

Stratum-layer

Melanin-melan-black

Spinosum-spin-thorn

Granulosum-gran-grain

Lucidum-luci-clear

Corneum-corn-horn

Papillary-papill-nipple

Sebaceous-seb-grease

Pili-pil-hair

Connection Examples:

- What layers of skin are penetrated by the long needle known as the *hypodermic needle*?
- Why do we call epidermal layers *strata* (i.e. *stratum basale*)? Think about the use of *strata* in naming layers of the Earth's atmosphere (i.e. stratosphere) and in referring to layers of rock.

What does *subcutaneous* mean? Relate this term to the words: *subway* and *submarine*. How cold is *subzero*? Has the class been taught by a *substitute* teacher?

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III. Human Skin Surface features: (ALL LEVELS)

Touch **SOAR** to various areas of the body and observe the following surface features:

- dead skin cells that form the keratin surface
- hair growing out of pits and some pits with no hair protruding from the hair follicle
- sweat gland openings that glisten with sweat
- blood vessels that run underneath the upper layer of cells vary in size; distinguish small vessels (capillaries and venules) from larger vessels (arteries and veins)
- bruises that are the result of damaged blood vessels bleeding into tissue
- skin color that is due to a variety of factors: the amount of melanin pigment, distribution of pigment, and variations in skin thickness (white and black fail to describe shades of color)
- scabs formed by platelets, white blood cells, and dead body cells overly new skin
- scars formed by injury that disrupts the epidermis
- freckles that are small patches appearing darker than other areas
- moles that are raised areas of skin
- blackheads formed by an accumulation of keratin and sebum in the pit openings
- lumps and pimples below the surface
- wrinkles that are shallow and deep
- tiny ridges on fingertips, palms and soles of feet (hairless areas)
- nails that arise from nail beds

IV. Examples of Related Activities: (ALL LEVELS)

- While examining their skin with SOAR, students record their observations by drawing and labeling pictures of skin surface features.
- After examining skin on the back of hands, soles of feet, arms, and legs, students draw a simple body diagram and label various areas of skin thickness by using the comparison adjectives: *thick, thicker, and thickest*.
- Students record their individual observations and collect class data on observations of various skin features, their body locations, frequency (i.e. how many freckles, hairs per area of skin), etc.
- Students create a class survey designed to investigate whether or not there is a link between observed skin features and personal sketches (i.e. age, ethnic background, lifestyle/habits to include hobbies, number of hours spent indoors and outdoors, use of sun protection to include sunscreen/hat, use of face-make up); students will probably share their observations and conclusions about the skin of people they know (i.e. the skin of an older person compared to that of a baby; the skin of a person who works/spends lots of time outdoors compared to that of one who works/stays indoors) or may do research on skin care. Students compile their information and present as a written or oral report.

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V. Blood Vessels in the Dermis of Human Skin (HIGHER LEVELS; simplify for ELEMENTARY)

- Blood vessels in the dermis supply the skin with food and oxygen. If the skin is accidentally cut, these are the vessels that bleed.
- Large vessels are easily observed on the back of the hands and on the inner arm because they look like branching rivers; these vessels are more easily seen as a person gets older because the skin thins with age.
- Smaller blood vessels branch from larger vessels and are found immediately under the epidermis.
- Skin is involved with temperature regulation. When the body is hot a person's skin looks red/flushed as the blood vessels widen (dilate) to allow body heat to escape; when the body is cool, the skin may become paler as the blood vessels narrow (constrict) to prevent heat loss.

A. Use **SOAR** to observe the many small blood vessels located in skin. Many small vessels (capillaries) appear as small red dots because they are found immediately under the epidermis. See if you can locate a "spider vein" that is a small vessel near the surface.

Discussion

- What causes the lips to be redder and darker than the surrounding skin?
- Do you think that the number and distribution (location) of blood vessels in the skin contribute to skin color?

B. Use **SOAR** to demonstrate the effect of cold temperature on blood vessel diameter.

- 1) Choose an area of skin that has lots of blood vessels (i.e. patches of spider veins).
- 2) Draw a circle on the skin with a pen or use a single adhesive paper hole reinforcement ring to isolate an area of skin.
- 3) Record the image of the skin in the circle.
- 4) Place an ice cube on the skin for about four minutes.
- 5) Record the image of the cold skin in the circle.

Discussion:

- Was there a noticeable change in the diameter of the blood vessel upon cooling the skin?
- Did the area of skin become lighter/paler as it was cooled?
- If the experiment was unsuccessful, what are some of the reasons it might not have worked well?

VI. Keratin, Dander, and Skin Waterproofing: (ALL LEVELS)

- **Keratin** is a protein from which nails, scales, feathers, claws, horns, and hooves, and antlers are formed.
- In humans, keratin deposited in dead cells makes up the layer of skin called the *horny layer or stratum corneum* (ever heard of a *corn* on the toe?). This waterproof layer has been compared to plastic wrap because it is thin and tough.
- Humans shed constantly, thus **dander** refers to dead cells of the stratum corneum and is a major component of ordinary household dust.
- Besides the dead cells filled with keratin, further skin **waterproofing** is added by **sebum**, the oily secretion of the sebaceous glands that are associated with hair follicles. Sebum keeps water out of our bodies when we wash and swim and prevents fluids from inside our bodies from escaping. Sebum also makes the hair oily!

A. Use **SOAR** to observe the surface layer of skin and to observe dander. (ALL LEVELS)

- 1) Observe the shiny (refractile) nature of dead surface cells that are actually bags of keratin.
- 2) Explore skin looking for flakes of dead skin cells known as dander
- 3) Collect dander: Use the sticky side of a 2 inch x 2 inch piece of clear packing tape to blot various areas of skin. Touch SOAR to the shiny surface of the tape to observe the collected dander. Compare the tape with the dander to a piece of unused clear tape.
- 4) Create dander: Draw a circle on the skin with a pen or use a single adhesive paper hole reinforcement ring to isolate an area of skin. Use SOAR to initially record an image of the skin within the ring. Next, use the tip of a plastic spoon to gently, but firmly, make five, back and forth scrapings of the skin surface within the ring. Do not break the skin by pressing too hard with the spoon. Use SOAR to observe an increase in whitish markings and flakes known as dander. Record the image of the scraped skin and compare with the previously stored image.

Discussion:

- What is dandruff?
- How do you think the shampoos that treat dandruff work?

B. Use **SOAR** to understand the role of sebum in waterproofing skin. (HIGHER LEVELS)

- 1) Take two pans of water.
- 2) Coat one hand with baby oil and leave one hand clean. Plunge both hands into separate pans of water and wait (immersion time may vary).
- 3) Dry both hands before examining skin closely with SOAR to see which hand wrinkles first.
DO NOT ALLOW SOAR LENS TO GET WET!

Discussion:

- Did the hand with baby oil allow or prevent natural sebum from being washed away?
- Why do we use lotion on our skin? Conditioner for our hair?

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VII. Use **SOAR** to understand the role of an astringent. (HIGHER LEVELS)

Astringents, like 70% alcohol and witch hazel solutions, are popular chemicals used to remove skin surface oils (sebum) and minimize pore size. Follow safety rules when using chemicals.

- 1) Draw a ring with a special pen or use a single adhesive paper hole reinforcement ring to isolate an area of skin on the outer arm.
- 2) Use SOAR to record an image of the skin within the ring.
- 3) Treat the skin within the ring with a 70% alcohol pad and allow the skin to quickly air dry.
- 4) Use SOAR to record an image of the alcohol-treated skin.
- 5) Compare the two recorded images side by side.
- 6) Communicate the conclusion of the experiment by written or oral presentation.

Discussion:

- Do you notice a less wrinkled surface when skin is treated with alcohol?
- Is there a measurable change in pore diameter?
- Does the use of an astringent make the skin feel tighter/drier?

VIII. Nail Hygiene: (ALL LEVELS)

It is important to have good hygiene and keep skin, hair and nails clean.

A. Use **SOAR** to observe nail beds and dirt under nails.

- 1) Ask for two student volunteers.
- 2) Direct one student to not wash hands; direct the other student to use soap/brush to thoroughly wash hands and to clean nail beds and under nails.
- 3) Use SOAR to compare the nail beds and under-nail areas of both students.

Discussion:

- Hands should be washed regularly with special effort made to clean under nails, especially after trips to the bathroom.
- Do you think we spread germs that cause disease by not washing our hands?
- Who wants to eat food prepared by someone who doesn't wash his/her hands?

IX. Play Skin Dermatologist (ELEMENTARY LEVEL)

Discuss the medical doctor known as a *dermatologist*. What does the word *derma* mean? What does a dermatologist specifically do? Do you think a dermatologist might use **SOAR** as a tool to better view a patient's skin?

A. Use **SOAR** to examine skin conditions and suspicious skin structures. Students should easily locate freckles, moles, wrinkles, and dander. Ask students what healthy skin looks like.

Discussion ideas:

- Skin Cancer: Discuss how skin cancer involves skin cells that are dividing rapidly (growing out of control) and that some of the skin cells may break off and travel in the body causing cancer in other parts of the body. Remind students that the REAL skin expert, a dermatologist, should examine strange looking freckles and moles in case they are cancerous.
- Natural skin protection: Discuss how the skin tries to protect itself from strong sunlight by producing extra pigment (melanin) and this causes people to *tan*. If a small patch of skin makes more melanin than the surrounding skin, the patch is called a *freckle*. People whose ancestors lived in sunny climates have darker skin due to an increase in pigment.
- Skin protection: Discuss the need for extra skin protection from the sun and how sun exposure and sunburn may lead to premature aging (wrinkles) and skin cancer. Have students noticed that the skin of a person who is older and spends lots of time outside is more wrinkled than that of a young person? Should a person wear sunscreen and protective clothing while in the sun?

B. Play Skin Dermatologist (HIGHER LEVELS)

Use **SOAR** to examine skin conditions and suspicious skin structures.

Discuss cosmetic issues as well as serious skin conditions. For recognition methods and to learn more about what appears normal and not normal, visit local dermatology clinics for literature and visit websites for information and photos. Discuss the dangers of not recognizing suspicious skin conditions. ALWAYS SEEK THE OPINION OF A PROFESSIONAL (playing with SOAR will not make you a dermatologist!)

Some Skin Conditions:

- Wrinkles
- Dander (dandruff)
- Psoriasis
- Skin Cancer: Basal Cell Carcinoma, Squamous Cell Carcinoma, Malignant Melanoma (these names really make sense when linked to skin layers)
- Rosacea
- Herpes Zoster (Shingles)
- Scabies

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X. Study Human Fingerprints (ALL LEVELS)

Every person (identical twins are the only exception) has a unique pattern of tiny ridges on the pads of their fingers. Police make prints of a person's fingerpads and use the *fingerprints* as a method of identification. When a crime is committed, crime scene investigators look for fingerprints left behind on hard, shiny surfaces.

There are three main patterns seen in a fingerprint: the loop, the arch, and the whorl.

Use **SOAR** to view fingerpads and fingerprints.

- 1) Compare the pattern of ridges on right and left index (2nd) fingers. Record each fingerpad and store the two images (A and B) side by side for comparison.
- 2) Use an ink pad and white paper to create fingerprints of the right and left index fingers. Record each of the prints and again, view A and B images side by side for comparison.
- 3) Compare the fingerprints of two students and try to locate some of their differences.

Discussion:

- Are there any differences between the finger patterns of the right and left index fingers of the same person?
- Is the fingerprint a loop, arch or whorl pattern?
- What were some of the differences noted when comparing fingerprints of two students?
- Take a print from another part of the body. Why do other parts of the skin have a different patterns of lines and wrinkles?

XI. Human Skin Research and Writing Ideas (HIGHER LEVELS)

- Why is skin considered an organ?
- Do nails and hair continue to grow after death?
- What is the function of human hair? How does the function of human hair differ from that of mammal fur and bird feathers?
- Why is skin keratinized?
- What is the role of skin pigmentation?
- How does the skin tan when exposed to sunlight?
- How are cells replaced in the epidermis?
- What are the differences between young and old skin?
- Why do people whose ancestors lived in hot and sunny climates have darker skin?
- Why were sailors of old (and maybe still) described as having ruddy complexions?
- What is dander?
- What are liver spots?
- What is acne? What are blackheads and pimples?
- What lives on your skin? Discuss bacterial flora and mites. www.bact.wisc.edu

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- Why are collagen injections used cosmetically as wrinkle minimizers?
- Does smoking increase wrinkles?
- What is the difference between a scab and a scar?
- What causes goose pimples and why are they called *goose pimples*?
- What is the reason for *oily hair*?
- What happens to blood vessels in the dermis when you get hot? Cold?

Explain the truth of these axioms and think of others:

- *“Beauty is more than skin deep”*
- *“He/she is thick skinned”*
- *“I was scared out of my skin”*
- *“I was so scared, my hair stood on end”*
- *“Skin the cat!”*
- *“Can’t judge a book by its cover”*

XII. Human Skin Compared to Other Land Animals (ALL LEVELS)

- Use **SOAR** to examine human skin and skin from various land animals.

NOTE: See *Animal Coverings* lesson by A. Steele <<http://www.scopeonarope.lsu.edu>>

Discuss skin as an **adaptation** for life on land and how skin varies among different animals (**comparative anatomy**).

- Do dogs have sweat glands? How do they cool off?
- Why do many amphibians have thin moist skin?
- What do human and reptile skin have in common?
- What actually is a snake skin? Why is it shed?

Discuss **camouflage** as a skin adaptation that allows animals to hide from predators.

- Why do soldiers/hunters wear uniforms that blend in with their environment (i.e. desert)?
- Paint a rock to resemble the skin of a particular animal in the environment. Prior to painting, take the rock outside to choose the best colors and patterns that would **camouflage** (hide) that animal in the environment.
- What do the **startle/warning colors** (i.e. black and yellow stripes on many insects and snakes) mean? Why are caution signs painted yellow? Why are red colors associated with heat and danger and even rage (think how red a person gets when he/she is really angry).

XIII. Human Skin Compared to Plant Outer Coverings (ALL LEVELS)

- Use **SOAR** to observe the surface of various leaves. Like people, plants live on land and need special adaptations to keep from drying out. Plants have an outer covering known as the epidermis that makes the **cuticle**, a special waxy coat to waterproof the plant. Magnolia and camellia leaves have a thick cuticle that gives the leaves a rigid, waxy texture. Some leaves have special **hairs** that serve to protect. Feel the surface texture of leaves.
- Use **SOAR** to examine the pores on the surfaces of different leaves. Plant have numerous, small **pores** (stomata) on the outer surface that function like small doors to allow gas exchange (carbon dioxide in and oxygen out during the sugar making process of photosynthesis). Does the pattern of pores resemble human skin and its pattern of hair follicle pits?
- Use **SOAR** to examine the outer surfaces of various plant leaves (choose green leaves whose primarily pigment is chlorophyll as well as leaves that have a variety of colors (variegation) due to the presence and distribution of several different pigments. Like human skin, **pigments** determine plant color. The petals of a flower are actually special leaves that owe their color to special pigments.
- Use **SOAR** to observe the veins within various leaves. Both plants and humans have a network of **veins/vessels** that serves as a transportation highway for vital substances. However, there are major differences between the structure of the veins/vessels and the nature of the transported substances: plant veins contain no blood, but contain water and minerals (xylem) and sugar and hormones (phloem). Note the main vein running through the center of the leaf and the numerous smaller branching veins.