Skin Deep? 1
- The reason Goodman, et al. begin a discussion of the specifics surrounding human variation with a focus on skin color is obvious: Most Americans begin their physical classification there.
  - If you look at Figure 8.1 you will see why skin color is considered to be a continuous trait rather than one that is discrete (able to be broken into distinct groupings).
  - But, while this chapter concentrates on the aspect of skin color that is linked to melanin, there are actually several chemical contributors to what makes-up our skin tones.
- Human skin color ranges across the tans and browns, but not across the blues or greens for instance.

Skin color variation has a rather simple biological cause, as discussed earlier: it reflects mostly the present of melanin, but skin color is produced by melanin, hemoglobin and carotene:
- Melanin is a pigment produced in the skin.
  - Melanin is responsible for the majority of variation in lightness and darkness in skin color, controlled by at least 6 genes. The light skin of Europeans and of Asians may be due to different genes, suggesting independent occurrences.
- All people have about the same number of melanocytes. The primary difference in skin color is in the amount of melanin produced by the melanocytes
  - Melanin is secreted by melanocytes in the bottom (5th, basal) layer of the epidermis (skin).
  - It is also found in iris of eyes and in our hair bulbs.
- There are two types: eumelanin (dark or brown) and pheomelanin (light or red brown).
- Hemoglobin is another pigment affecting skin color which gives oxygenated blood cells their red color.
- Carotene provides a yellow to orange factor.
- Thickness of the outer skin layers also alters appearance.
- Age and sex can create differences in skin color.

Skin Deep? 2
- Skin color, the sun, and evolution
  - Skin color is darkest at the equator and tends to be lighter with the increasing distance from the equator, north or south.
  - There is also a hemispheric difference—skin color tends to be darker in the Southern Hemisphere (below the equator) than in the Northern Hemisphere.
    - Ultraviolet radiation is strongest at the equator and dims in strength farther from the equator.
    - It tends to be greater in the Southern Hemisphere than in the Northern Hemisphere.
  - The distribution of human skin color in the world today suggests past evolutionary events relating to natural selection.
    - Darker pigmented persons suffer more from frostbite and this can be a serious evolutionary pressure.
    - Dark skinned WWII soldiers are greater risk than light skinned.
    - This observation prompted some researchers to suggest the cold injury hypothesis.
  - As discussed earlier, dark skin evolved among our early ancestors in Africa as a means of protection against damaging effects of ultraviolet radiation. Later, as some human beings moved out of Africa, lighter skin color evolved farther away from the equator.
    - But, the picture is a bit more complex. For instance, the Inuit (an Arctic people) but their skin tone is not as light as one would expect if temperature or latitude was the main cause of the color variation.
    - So why are the Inuit more darkly pigmented than would be predicted?
      - The likely answer is solar glare off the snow pack.
      - Further, they eat lots of fish oils and so digest larger amounts of vitamin D₃ than most groups do.

Skin Deep? 3
- Sun: The motivator
  - Humans need the sun, for among other things, to help us manufacture vitamin D₃.
    - We do eat some of your vitamin D in our food (such as fish and meats, but we need more. [Or in my case, as a vegetarian, I need to eat soy, mushrooms and such, yummy).
• Figure 8.3 follows the biochemical pathway used by our body to make vitamin D₃ from the sun.
  • Ultraviolet-A light (UVA) causes aging and may be more damaging to your genes than once thought.
  • Ultraviolet-B light (UVB) is the one that helps make vitamin D₃, but also causes aging and skin cancer.
    • One issue is that at higher latitudes there is much less UVB during the winter months.
    • Also, our concern with UVA has us using sunblock that can also block UVB.
    • Staying inside on our computers is not helping either.
    • Nor does our bundling up to stay warm in the winter.
• So what are the effects of not producing enough vitamin D₃?
  • Children can develop rickets.
    • Among the symptoms is the softening of the bones, but other symptoms include interruption of several metabolic pathways.
    • The iconic symptom then is severe bowlegging, to the point of disability. The list of symptoms is lengthy, though.
    • In pregnant women, with deformed pelvises, it can be life-threatening during birth.
    • Low vitamin D₃ levels have also been linked to muscle cramps/spasms, autoimmune diseases such as diabetes and there are links to cancer prevention.

Skin Deep? 4
• Sun: The motivator (continued)
  • Another issue is associated folate (also called folic acid or vitamin B₉).
    • The damage to folic acid from solar radiation was proposed by John Eaton (reported in Jablonski and Chaplin article mentioned in the book).
    • Folate deficiency alters the sperm and leads to male sterility.
    • Developing fetuses can be harmed (spina bifida).
  • So there is a balancing act going on between the benefits/stressors for vitamins D₃ and B₉, according to Nina Jablonski.
    • Because the amount of sunlight differs between regions darker or lighter skin color may be an advantage.
    • So we need to protect vitamin B₉ and produce vitamins D₃.
  • At 200,000 our ancestors were likely living on hot, dry savannahs where they had developed darker skin and thinner hair follicles (better for sweating).
    • As a result of our ancestors migrating out of Africa into new environments after about 200,000 years ago a balancing act became an issue.
    • What was once an adaptation to hotter savannah environments (dark skin) became a liability in the higher latitudes where UV light was lessened so lighter pigmented skin became the advantage.

Skin Deep? 5
• Measuring skin color
  • There have been several attempts to develop an objective measure for skin color. One such was the set of tiles produced by Felix von Luschan.
    • This set of tiles consists of 36 colors (see diagram on right).
    • Many of the lighter tiles look the same and there is a tendency to get different results each time you measure (because it is subjective).
  • Today, skin color is measured on the upper, inner arm (to avoid tanning effects) with a skin reflectance spectrophotometer.
    • The original machines were created for the garment industry and then retooled for skin measurements.
    • Because of the effects of melanin, hemoglobin and carotene on skin tone the measurements are taken across several wavelengths.
    • The idea behind these measurements is that lighter skin reflects more light.

Skin Deep? 6
• The evolution & meaning of human skin color variation (Nina G. Jablonski)
  • Historical perspectives
• The early Greeks and Romans speculated that skin color is linked to climate when they suggested that dark skin tones are produced by excessive heat and light skin tones by excessive cold.
• In the mid-1700s, Samuel Stanhope, an American, who identified that skin color varies with latitude. He went on to suggest that this gradient was linked to sunshine.
• In the mid-20th century, Frederick Loomis refined the relationship by linking skin color to UV light. Jablonski indicates that her research has found that 87% of the variation in human skin color is correlated with UV.

Skin Deep? 7
• The evolution & meaning of human skin color variation (Nina G. Jablonski, continued)
  • Skin and reproduction
    • While UV light causes skin cancer it rarely kills the patient in their reproductive years. This means it is not a strong evolutionary pressure.
    • More important to reproduction is UV’s effects on vitamins D₃ and B₉ as discussed earlier.
  • Skin and evolution in the tropics
    • Melanin is a very effective natural sun block, especially eumelanin (dark melanin)
    • Interestingly, apes produce melanin on their faces and hands by tannin, but they have dark hair covering the rest of their (light) skin.
    • She suggests that as humans “lost their hair” (really it thinned) there was pressure to produce dark skin on the entire body and it was permanent.
  • Skin and evolution outside the tropics
    • We are reminded that light skin is really “depigmented skin”.
    • This lightening of the skin happened twice in modern humans (once among Europeans and also among Asians) but also among Neanderthals.
    • When humans migrated to the Americas we see additional changes. There are populations living at high UV environments who gained the capacity to tan easily.

Skin Deep? 8
• The evolution & meaning of human skin color variation (Nina G. Jablonski, continued)
  • Cultural adaptations
    • In the last 10,000 years humans became ever more adapted to the use of clothing.
    • In very northern environments oily fish and sea mammals added more access to dietary vitamin D₃.
    • She suggests we also have issues of maladaptation:
      • We can move fast across environments due to fast transit but our bodies cannot adapt that fast.
      • We live inside and suffer from vitamin D₃ deficiencies.
  • Skin color does not explain deeper traits
    • Even as skin color is used as a “racial marker” it has value as an illustration of the explanatory LIMITS of biological race concept.
    • Skin color is not about race, it is about evolutionary adaptation to UV.
    • Further skin color demonstrates continuous variation.
    • Skin color does NOT explain many other variations given that it is only weakly linked with most other human traits.
    • Evolution, rather than race, exhibits great variation.