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| Evolution Of Skin Colour |
| Adv Bio 11 |
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What are the causes of skin cancer?

Some causes of skin cancer are over explosion to UV light, moles, as well it can be passed on hereditarily.

Why are Caucasians more at risk of skin cancer than other populations?

Caucasians have the lowest amount of melanin in their skin cells when being compared to other cultures. Melanin is crucial to protecting our skin from UV rays, and so someone with a darker skin tone is better protected.

At what age does skin cancer *typically* occur? Is the incidence of skin cancer greater in youth or old age?

Generally skin cancer is more predominant to youth aged 20-30.

Does the amount of UV light reaching the Earth vary in a predictable manner? If so, describe the pattern you observe.

By looking at the map, you can tell that areas where the earth is closer to the sun had a higher UV index, where as the places that are farther away (ie Antarctica) have a lower UV index.

What latitude receives the greatest amount of UV light? The least?

The highest amount of UV could be found across the equator (0 longitude) the least could be found from 60-90 and -70-(-90) longitude.

Based on these data, where might you expect to find the most lightly pigmented and most darkly pigmented people on the planet? Be as specific as you can.

The more naturally light people would be found in the far north or far south, the more naturally dark people would be found closer to the equator. This is of course assuming they are not a mix of multiple races.

Provide a rationale to your answer above (i.e., why did you think that more darkly pigmented people would be found in those areas)?

Well, people of darker skin tones are producing more melanin in their bodies, which is critically important in countries with high UV exposure. Those in the more northern/southern areas of the earth would have no use for such a high content, and so have a fainter pigmentation.

Is skin reflectance randomly distributed throughout the globe? If not, how would you describe the pattern?

The skin reflectance is not randomly distributed, by reading the graph we can see that in the upper and lower latitude extremes there is a higher skin reflectance. When we look at the reflectance of the more moderate numbers the reflectance is lower, so the population is darker skinned.

Restate your findings in terms of skin color and UV light (instead of skin reflectance and latitude).

Those populations who live near the equator are more exposed to UV light and so need more melanin, giving them a darker skin tone. People who live closer to the north or south of the planet would have a lighter skin tone.

How closely do these findings match the predictions of your hypothesis (Question 6)?

These findings matched what I said very well, one thing I found interesting though was how much higher the reflectivity of skin was in the far north compared to the south. The southern numbers were much more gradual that the steep slope of the north.

Some populations have skin colors that are darker or lighter than predicted based on their location (their data point falls somewhere outside of the line shown in Figure 2). What might explain the skin color of these exceptional populations? Propose a few hypotheses.

Well, the people of the south may be darker skinned due to a slightly stronger shift towards the sun than the north. Since the earth is on a tilt, the southern hemisphere may be receiving more UV rays.

This would also mean that the north is tilted just a bit away so it receives less UV, resulting in the people having a fairer complexion.

Hypothesize why different skin colors have evolved. Based on what you know, what factor is most likely to exert a selective pressure on skin color?

We have evolved to have different skin tones based on our ancestral origin. Different descents will have various skin tones based on where in the world they are located. Those with fair skin in an area close to the equator would have suffered from the strong UV rays, and their rates to develop skin cancer would have been much higher. We can darken and lighten to a degree, but extreme climate change would call for more dramatic affects.

10. Skin cancer can exert a lot on reproductive success, especially around ages 20-30, when skin cancer is more predominant, because that they time that people are usually getting married and having children.

11. My hypothesis was fairly accurate. Those born with very light pigmentation in a high UV climate wouldn’t have survived, at the same time it makes sense that as the genetics changed more offspring of the successful colour would have been produced.

12. The effect on the blood folate levels were that the exposed group had lower levels of folate left in the blood.

13. The effect on the folate concentration was that the exposed group again had lower levels then the non-exposed group.

14. Folate deficiencies during pregnancy can cause malformations in the nervous system and the gastrointestinal system. It can also cause miscarriages and because folic acid is important in embryonic neural tube formation, natural selection favored people with dark pigmentation because they could produce healthy offspring.

15. A light skin tone would be expected to be correlated with higher levels of folate because the darker you are, the UV rays deplete the folate levels.

16. Human populations living in areas of intense sunlight tend to be darker skinned because of the increases UV light. Populations living in areas of very little sunlight tend to be lighter skinned because of the lack of UV light.

17a. Light skinned people living in the tropics have a very low percent of reproductive success because the people who are dark skinned living there would probably be attracted to the same skin tone.

b. Light skinned people living in the polar region would have a high percent of reproductive success because the people living there are not very dark and would be about the same skin tone as the light skinned person.

c. Dark skinned people living in the tropics would have a very high percent of reproductive success because everybody there would most likely have darker skin and sexual selection may influence the attraction.

d. Dark skinned people living in the polar region would have a moderate percent of reproductive success because people living in the polar region are neither dark skinned nor light skinned, they’re mostly in between. Because of this, they may not have such a strong attraction to a certain skin tone.

18. The skin tones near the equator that I predicted would be very dark, the skin tones near the north pole would be light, the skin tones near the south pole would be very fair, the skin tones between the north pole and the equator would be light to medium skin tones and the skin tones between the south pole and equator would be medium skin tones.

19. Yes, because if the UV rays strip away the folic acid, different skin tones can appear.

20. Vitamin D is linked to natural selection because natural selection includes having characteristics that make them better adapted to their environment to survive. Vitamin D is used to maintain a healthy heart, stable nervous system and an effective immune system, all of which can help organisms adapt to other places needed for survival and to reproduce.

21. The skin tone that allows someone to maintain a recommended level of Vitamin D would be a darker skin tone. This is because lighter skin allows deeper penetration by UV rays.

22. The evolution of the variation and distribution of human skin color depends on where you live. People living close to the equator will have darker skin then people living in Alaska. It varies in different places around the world because as people moved to farther areas from the equator with lower UV levels, natural selection favors lighter skin which allowed UV rays to penetrate the skin and produce more vitamin D.

23. For all of these scenarios, I think that the reproductive success for every one of them would be the same because vitamin D does not really play a big factor in people choosing who to mate with.

24. Taking only vitamin D into consideration, I think that skin tones near the equator would be medium, skin tones near the north would be very dark, skin tones near the south would be very dark, skin tones between the north and equator would be light and skin tones between the south and equator would be light.

25. No, it cannot explain the distribution because the UV rays only help the body to utilize the vitamin D.

26. I predict that skin tones near the equator would be very dark, skin tones near the north would be dark, skin tones near the south would be dark, skin tones between the north and equator would be medium and skin tones between the south and equator would be light to medium.

27. Yes, they are because they all contribute to what the skin color is for each person.

28. My hypothesis for why the Inuit’s are dark skinned is because maybe they had an ancestor that lived close to the equator. The high UV rays produced vitamin D and that was passed on through the generations so even though they live in sub-zero climates. They also ate a lot of fish which contains a lot of Vitamin D.

29. My hypothesis for why Europeans are slightly-lighter skinned for their latitude is because of the hotter weather, they can grow grain products all year round. Because of this, grain products lack vitamin D and therefore their skin color is lighter.

Which populations have insufficient amounts of vitamin D in their blood?

East and South Asia

What is a common trait to all of these populations? How could this explain their deficiency?

South and East Asia both have a relatively high UV index so perhaps the genes in their ancestry stopped relying on wasting energy to harvest and consume vitamin D from foods because it could be so easily gained from being exposed to their atmosphere.

For several decades, milk and cereals have been fortified with vitamin D to help increase intake of this nutrient. Hypothesize why these fortification programs appear to be failing in some ethnic groups (there may be different reasons for different groups).

Not everyone within a population or the world for that matter will consume the same things. Since cows milk is generally only drank in the north/south America’s, and so this tactic would have no application towards those in other continents. To enrich products with vitamins, the product really has to be something designed for that specific population.

What should some Canadians do to avoid vitamin D deficiency?

If it’s winter, and the UV index is very low so synthesizing vitamin D isn’t an option, Canadians should look for products that are enriched with Vitamin D. Preferably though they should eat things that naturally have it such as fish oil and eggs. In the warmer months, just being outside with give a good boost to their vitamin D levels.

If individuals do not take steps to boost their vitamin D intake, hypothesize what might happen to their descendants in the future.

Well I think things could go two ways. Either future offspring will not be getting enough vitamin D while being carried through pregnancy and when born will have mutations. Or we will begin to be more receptive to the vitamin D that the sun gives us and will be able to gain it more easily.

What might happen to Australians of European descent over time?

Since Australia has a much higher UV index then most of Europe, they may start to lose some of their Vitamin D producing components because they will not need as much.

36. Forces that affected the evolution of skin color in the past could be where the individual lived and how much fish they ate, because fish is a good source of vitamin D.

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| **PAST** | **PRESENT** |
| -location (closer to the equator)  -eating lots of fish | - The amount of time people spend out in the sun.  -Vacationing closer to the equator  -Vitamin D supplements tablets for in the winter when the UV rays aren’t as strong. |

Future: in the future, skin color may be affected by fake tanning booths, more harmful UV rays from the depletion of the ozone layer, and for lighter skin, fish can start to become less available meaning loss of vitamin D.

1. The impact of natural selection is not as strong as it was in the past because we have ways to protect ourselves from the sun.
2. Factors that may have decreased today is the amount of awareness people have about skin cancer and how much more protection choices we have against the harmful UV rays. Factors that may have increased today is the amount of tanning booths and ways that we can protect ourselves and limit the amount of time we spend out in the sun.
3. I have two predictions:

- With the ozone layer depleting, the UV rays will become much more higher, making it easier for people to tan. Also, with this happening we can come up with other ways to protect ourselves, i.e. sunscreen.

- People have been travelling all over the world for the past couple of years and more people are travelling to tropical places with higher UV rays. This could also lead to darker skin tones.

37. Yes, the individual would be adapting to the environment because if they are trying to tan in an intense UV region, there is a good chance that the people living there are tanned too.

38. Yes, because if they are fair skinned, they may not be used to high UV rays meaning they could get a very bad burn.

39. They should still wear sunscreen to help prevent skin cancer, but it wouldn’t be as big of a deal if they didn’t wear any.

40. Yes, this observation could be a result of natural selection because being a darker skin tone may be attractive to certain people and it may be what they’re looking for in a mate.

41. Yes, this observation could be a result of natural selection because the amount of melanin they can produce is depending on their genes.