

~ SCIENCE SAMPLER ~

Unit 5 of 5

Biology

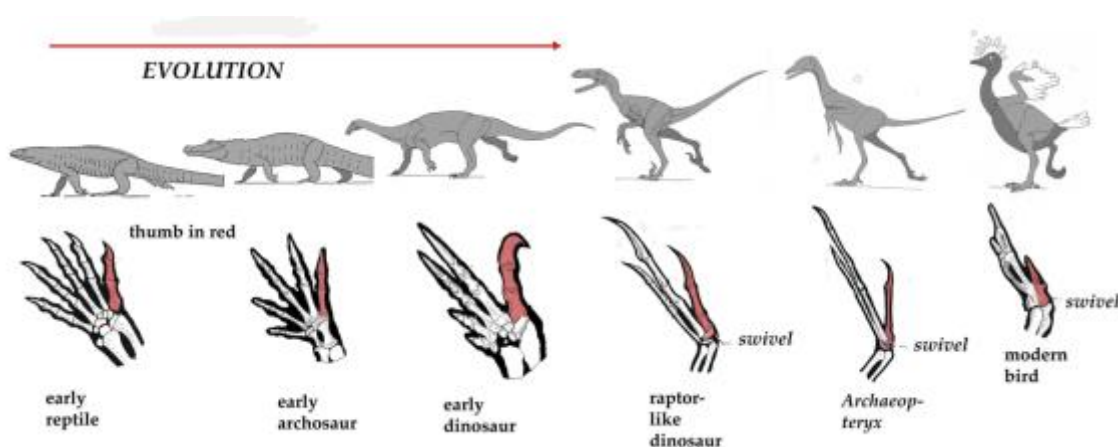
In this unit, we will focus on life: the evolution of organisms, their structures and functions, why certain species survive, how some species evolved into other species, and ultimately how humans evolved.

Part 1: Darwinism

The theory of evolution is also referred to as Darwinism because it was proposed by a naturalist named Charles Darwin. How did humans appear? Did we just appear from nothing? Darwin's theory of evolution solves this mystery. The theory of evolution claims that all species are related to a common ancestor. All the species that you see today didn't just come to be. Complex lives evolved from very simple forms of life. Species that could adapt were selected by nature – a process called natural selection – and then those species evolved into more complex species. Those other species that did not have a functional advantage to adapt eventually died out. But those that survived and evolved started inheriting variations, which better allowed them to survive and reproduce. The species that started to accumulate beneficial mutations passed those beneficial mutations on to the next generation, over time resulting in the creation of a totally different species. The basic premise taken from Darwinism is the idea that everything is related.

1. **Darwin's theory assumes that evolution is a very slow (very, very slow) process! Do you think that it is valid? Why or why not?**

A classic example is the evolution of birds! There is evidence that supports the idea that birds evolved from dinosaurs!¹



2. **How could the study of geology confirm or refute Darwin's theory of evolution?**

3. **Give an example of a genetic mutation that would benefit a reptile.**

4. **Give an example that would benefit a bird.**

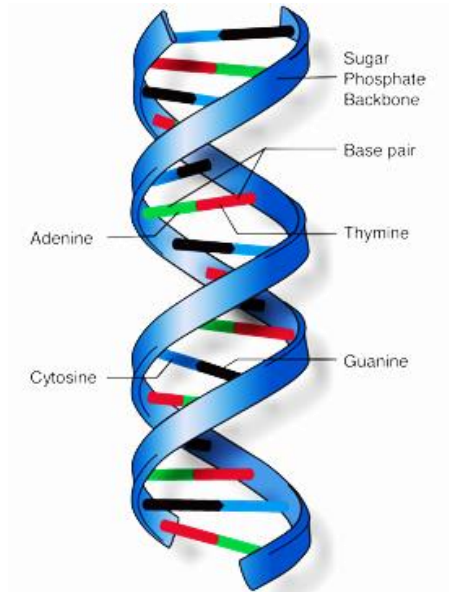
5. **Give an example that would benefit a fish.**

Part 2: DNA

In part 1, we saw that as species evolved, their beneficial mutations were passed on to the next generation. But how are traits passed from parents to offspring? DNA is the key; DNA is the code.

6. What physical traits do you have in common with other family members? Elaborate as much as you can. What personality traits do you have in common? [You can describe a friend and his or her family if you would prefer.]

DNA or Deoxyribonucleic acid is a series of molecules that contain genetic information and control our cells' activities. It can replicate information.



Looking at the picture above², DNA's structure is what's called a "double helix". It is made of two strands, which consist of alternating sugar and phosphate molecules. Attached to the sugar and phosphate, there are four bases: adenine, thymine, guanine and cytosine.* Adenine is allowed to pair only with thymine (and vice-versa), and guanine is allowed to pair only with cytosine (and vice-versa). Different arrangements of those base pairs create a different person! You are unique as an individual; you have your own individual DNA code.

An acid is any chemical compound with a PH less than 7. PH is the level of concentration of hydrogen ions in a solution. A base is the opposite of an acid; it is any chemical compound with PH higher than 7; the PH of a base can go up to 14. PH levels affects the health of the ocean, sky, and even our blood.

7. Environmentalists talk about the danger of "acid rain". Why would you guess this is a concern and what would the cause be?

DNA Mutation

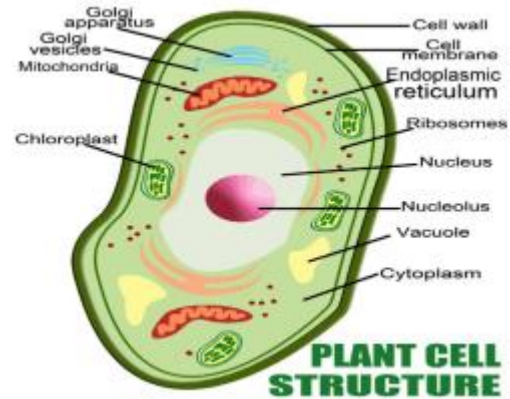
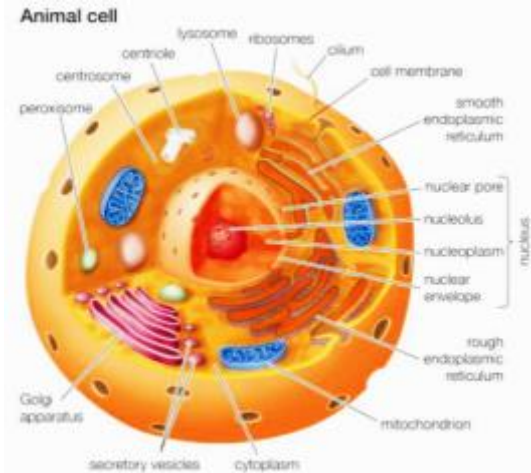
When cells divide, DNA must make a copy of itself so that the new cell gets all the same genetic information. This process happens all the time in our bodies. But sometimes errors happen, resulting in **DNA mutations**. Some of the factors that could contribute to DNA mutations are: ultra violet light from the sun, smoking, radiation, and viruses. Some of the DNA mutations are passed to the next generation, so that the offspring will have mutated DNA.

8. Pretend you are a doctor. Explain to your patient why you need his family medical history, (such as diabetes and cancer), without alarming him.
9. Think of a DNA mutation that can make a person healthier.
10. Pretend you are the parent of a child who was born with a handicap caused by a DNA mutation. Explain to your child why he or she is different from other children.

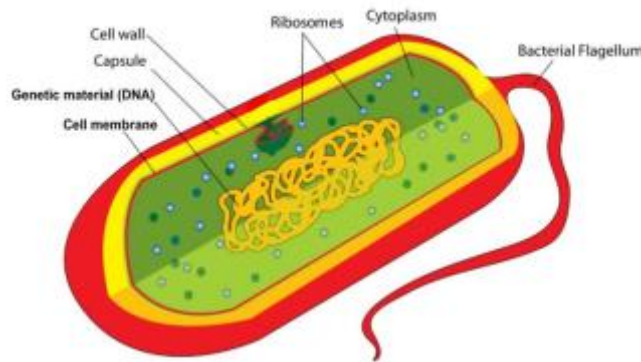
Part 3: Cells

Where in our bodies do we find DNA? The answer is in cells.

Cells are sometime referred to as the “building blocks of life”. Cells are the fundamental units in all living organisms. Based on their number of cells, organisms can be categorized into unicellular, consisting of a single cell, or multicellular, consisting of more than one cell. Bacteria are examples of unicellular organisms, and plants are examples of multicellular organisms. As we learned from the geology unit, the first unicellular organism emerged 3.5 billion years ago on Earth. Below are pictures of an animal cell³, plant cell⁴, and bacteria cell⁵.



Bacterial cell



11. Based on those pictures, name three differences among animal, plant and bacteria cells.

Cell Specialization -- Are the cells in your arm the same cells in your brain? As an adult, you have approximately 100 trillion cells in your body, and 200 different specialized cells. A cell can selectively activate or inactivate some specific genes, which allows it to have a specific function in your body—that is what is called cell specialization. Each cell has around 30,000 genes, but not all genes are found in every cell. So cells differ in their structure and function in different parts of your body! For instance, instead of doing multiple jobs, your red blood cells are responsible for carrying oxygen throughout your bloodstream.

12. What is one responsibility for the cells in:

- (a) a muscle
- (b) the heart
- (c) the nose

Part 4: The Evolution of Humans

When it comes to human evolution, primates aren't just our closest ancestors -- we evolved from them!



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13. Identify three similarities and three differences between humans and primates (gorillas, chimpanzees, etc.).

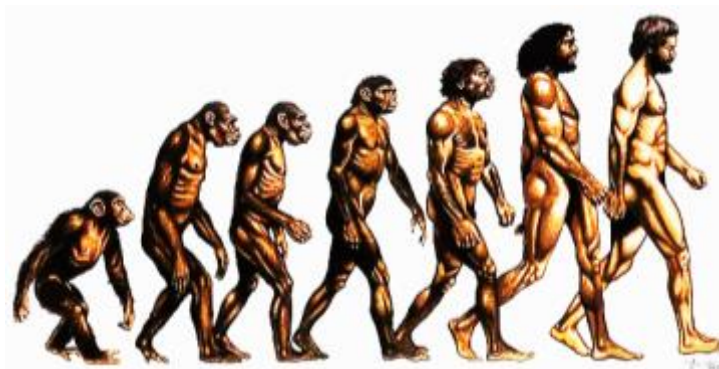
Millions of years ago, our ancestors used to live in trees, but due to some environmental changes, they were forced to leave the trees. They had to develop new traits, such as standing on two feet. Their brains started to change, including becoming larger. Eventually, almost like magic, they were like us.

14. Use Darwin's theory to explain the evolution of man.

15. What are the advantages and disadvantages to living in trees?

16. What environmental changes would have created the need for tree-living animals to move to the ground?

17. Do you think humans are still evolving, developing new traits? If yes, what are those traits? If not, why did we stop evolving?



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18. Assume humans, as we know them today, continue to evolve into a new species. What do you imagine that species would be like?

19. Our brain size is bigger than our ancestors'. How has our brain size affected our intelligence?

When children in this country are given the same standardized tests that children were given 50 years ago, their average scores are lower!

20. Does this mean that humans are less intelligent than we were 50 years ago? Explain.

21. List three ways children today are less intelligent and three ways they are more intelligent.

Often, adults can no longer answer the questions they could in elementary school.

22. List three ways in which children are smarter than their parents!

23. Design an intelligence test.

24. Write an essay about any aspect of evolution.

CONCLUSION

Have we answered our main question of this course—*Where do we come from?* Even after taking a whole course, covering astronomy, physics, chemistry, geology, and biology, we still don't have a definite answer to that question. But there is one thing we know for sure: once upon a time, you were a star! As astronomers say, you are "star dust"! Once, when he was asked what is the most astounding fact, astrophysicist Niel Degraesse gave the most beautiful and touching answer:

The most astounding fact is the knowledge that the atoms that comprise life on Earth, the atoms that make up the human body, are traceable to the crucibles that cooked light elements into heavy elements in their core under extreme temperatures and pressures.

These stars, the high mass ones among them, went unstable in their later years. They collapsed and then exploded, scattering their enriched guts across the galaxy. Guts made of carbon, nitrogen, oxygen, and all the fundamental ingredients of life itself.

These ingredients became part of gas clouds that condense, collapse, form the next generation of solar systems, stars with orbiting planets. And those planets now have the ingredients for life itself.

So that when I look up at the night sky and I know that yes, we are part of this universe, we are in this universe, but perhaps more important than both of those facts is that the universe is in us. When I reflect on that fact, I look up—many people feel small because they're small and the universe is big—but I feel big, because my atoms came from those stars. There's a level of connectivity.

That's really what you want in life, you want to feel connected, you want to feel relevant, you want to feel like you're a participant in the goings-on of activities and events around you. That's precisely what we are, just by being alive.



THE UNIVERSE IS IN YOU!

Congratulations on completing College Guild's Science Sampler course! One final assignment:

25. Which branch of science interested you the most and why?

26. Would you be interested in learning more about the universe?

Because Science Sampler is a new course, your feedback on each unit is valued. Please take a few minutes to tell us what you liked, didn't like, would change, want to see more of, etc. in each unit. Thank you! We hope you enjoyed the course.

FEEDBACK

Unit 1- Astronomy

Unit 2- Physics

Unit 3- Chemistry

Unit 4- Geology

Unit 5- Biology

General comments/suggestions:

Remember: First names only & please let us know if your address changes

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