Evolution and Species

Suppose two individuals—such as a bumblebee and a dog—have such different genes that their gametes can't meet and form a new individual. We say the two individuals belong to two different **species**. When we say "different species," we mean individuals that can't produce viable offspring together.

Think again about our frogs, separated by an earthquake. Imagine that, over time (hundreds of thousands of years, perhaps), the frogs in Place 1 undergo so many changes to their gene pool that they wouldn't be able to mate with the frogs in Place 2, even if they were brought together again. The frogs in Place 1 and the frogs in Place 2 would be considered separate species. We would say then that evolution caused **speciation**.

> Speciation is simply the formation of a new species, by evolution.

Another way to describe what happened to the frogs is to say they underwent **divergent evolution**. Divergent evolution is the process by which two populations of the same species end up having different behaviors and traits. They used to have similar traits, but as a result of a changing environment, they changed, and over time, their behaviors and traits were no longer similar; in other words, they **diverged**. In the case of the frogs, the pressure to change came from the fact that the different environments had different types of predators.

If the evolution of the populations continues, and after a very long time the populations can no longer mate and produce offspring (which is what happened to our frogs), then the two populations are now two separate species—speciation occurred. So speciation is just the extreme form of divergent evolution.

Sometimes, similarities in structure among species give evidence of their evolutionary history. One example is in the forelimbs of all mammals: these all consist of the same skeletal parts. Obviously, the function of a whale's flipper is very different from that of a bat's wing. But these have similar structures, despite their differing functions. **Homologous structures** are common in species that share a common ancestor.

What If Two Populations Become More *Similar* to One Another?

Consider a population of rodents and a population of insects that inhabit the same environment. Suppose that in this particular environment there are many ground-dwelling predators. If the rodents and the insects could somehow get off the ground, they would be safe from the predators. Suppose further that through mutation and genetic variability, and over a long period of time, the insects developed a set of modified legs that could expand to act as glider wings, so that whenever a large gust of wind came around the insects would become airborne. This would keep them off the ground and away from the predators. More of them would survive, and, gradually, the majority of this population of insects would have this "flying" ability.

What about the rodents? What if, also through mutation and genetic variability, over this same long period of time, they developed extensive skin folds between their front and back legs that allowed them to remain airborne when leaping from tree to tree?

Clearly the two populations—the insects and the rodents—could never mate and produce offspring. But they have become more similar to each other in terms of behaviors and traits. Both populations developed specialized structures that allowed them to "fly." In other words, their traits and behaviors converged. Evolution that results in the production of similar traits and behaviors between two separate populations and/or species is called **convergent evolution**.

Something to remember about convergent evolution is that it NEVER results in speciation (the formation of two separate species). Furthermore, it can NEVER bring two completely different species into a single species.

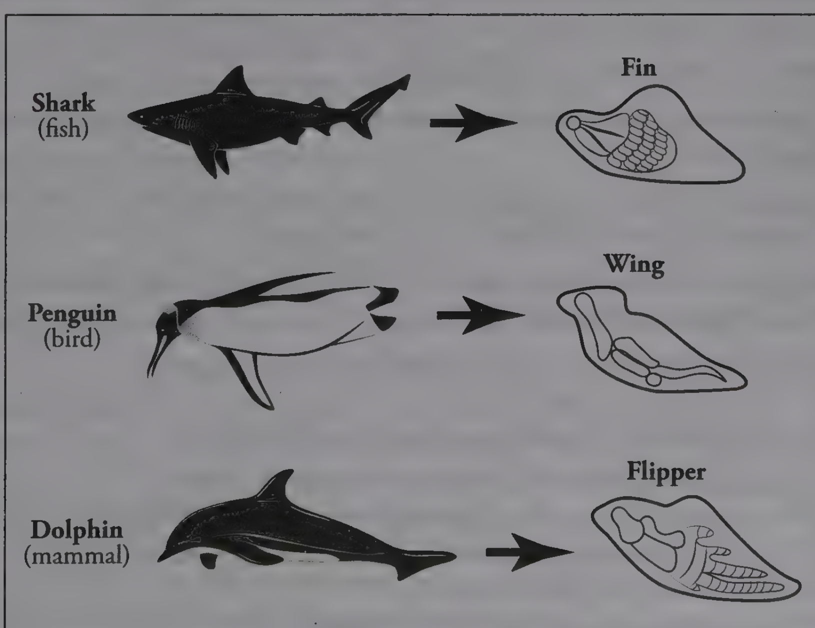
It is important to recognize that not all similar structures are inherited from a common ancestor, or homologous. In the example above, the insects and rodents both have wings. However, these are not homologous structures, they are analogous. **Analogous structures** are similar adaptations that result from convergent evolution.

Homologous vs. Analogous Structures

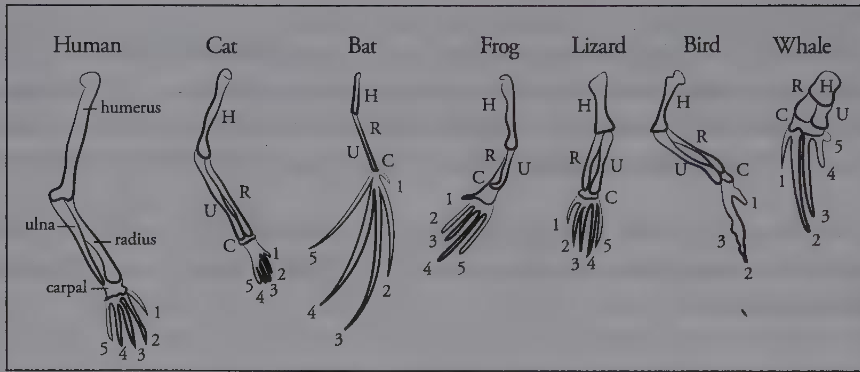
In summary, here are some of the key differences between these two structures.

Type of Structure	Analogous	Homologous
Functionality	Same	Different
Fundamentals	Different	Same
Ancestry	Different (convergent evolution)	Common (divergent evolution)
Examples	Wings in birds/insects	Human arm and whale flipper

The following illustrations also help to show commonalities and distinctions between these two types of structures.



Analogous Structures



Homologous Structures

One Last Thing to Remember

As a population evolves because of pressures from its environment, sometimes structures that were important at one time become unimportant as the environment, the population, and the population's behaviors change. These useless structures become smaller and smaller and eventually are not seen in the organisms except as remnants of their former selves. These remnants are called **vestigial structures**. Examples of vestigial structures are the appendix in humans and leg bones in snakes.

[redacted]

1. [redacted]

[redacted]

3. [redacted]

[redacted] ____________.

5. [redacted]

[redacted] ________ [redacted].

[redacted]

Correct answers can be found in Part IV.