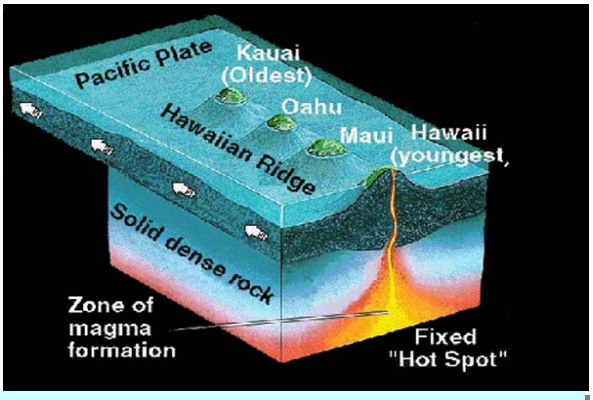
Hotspots of Adaptation

Below the giant tectonic plate that makes up the floor of much of the Pacific Ocean is a plume of magma, called a hotspot, that is responsible for creating the Hawaiian Islands. The Hawaiian Islands are part of a chain of volcanoes, most of them submerged seamounts that stretch for almost 6000 kilometers. A few of these are above the surface of the sea. They are considered not only hotspots for volcanic activity but also hotspots for biodiversity and the process of evolution.



The Hawaiian Islands are a chain of volcanoes that have formed as a tectonic plate has moved over a volcanic plume or hotspot.

Islands have long been known to provide homes for a wide variety of species. Many species are unique to a specific island or group of islands. How did all of these unique species arise? Why are these islands such havens for biodiversity? Careful studies of island species indicate that they are related to other species that are found on continents. Some of these continents may be thousands of miles from their island homes. This huge diversity of species in a relatively small area includes an array of organisms from microbes to birds.

The Hawaiian Islands are over 3000 km from the nearest continent, and yet they have a high biodiversity with many unique species. How did these species arise?

Studies of Hawaiian fruit flies have shown that the islands have over 500 species. The different species have different shapes and sizes. Some are as small as 1.5 millimeters long, while others exceed 20 millimeters in length. The species may differ in the shape and color of their wings, the appearance and function of their mouthparts, or the appearance of their heads and legs. Studies of their DNA suggest that they all probably derived from one fly blown to the island chain about 8 million years ago. How did all of these different flies come from this one species? These fly species can be explained as an example of adaptive radiation. When the fly first arrived at the islands, there were only a few organisms living there. There were lots of vacant niches—different types of spaces and potential life-styles. Ancestors of the first fly had various characteristics. As this variety increased over time (through mutation), new forms evolved that could occupy vacant niches. Here they thrived, because there was little or no competition. Eventually these modified flies became so changed from the original ancestor that they became a new species. These new species continued to adapt to the huge variety of habitats available on the islands. For example, some were able to survive at higher

elevations or in drier regions. Some adapted to eat or lay their eggs on certain plants. New species produced their own offshoots creating a complex tree of evolutionary relationships. Some of these species probably became extinct, but today about 500 species remain. Continuing studies of these flies indicate that their evolution continues today. Populations of the same species on different parts of the islands are developing different features. Sometime in the future, these may evolve into two separate species.

Adaptive radiation, where one species gives rise to many others, is a feature of life on islands. On Hawaii, many of the birds also exhibit this pattern. The Hawaiian honey creepers, a group of birds once at least fifty-five species strong, arose from one colonizing species. Some of these species were adapted to extract nectar from different flowers. Some evolved long, highly curved beaks for getting the nectar from the flowers only found on Hawaii. Others turned to eating insects. Some evolved thin beaks for picking insects from leaves, while others developed strong, hooked beaks for getting wood-boring insects out of tree bark. Others developed thick, strong beaks for cracking open seeds. Sadly, many of the bird species that evolved on Hawaii have become extinct since humans arrived on the islands. Only eighteen species of honeycreeper remain on the islands, and many of these are threatened with extinction.

Islands around the world are hotspots for biodiversity that have arisen rapidly though adaptive radiation. It is not surprising that the unique species on the Galapagos Islands acted as one important catalyst for Darwin's formulation of the theory of natural selection. Darwin's contemporary, Wallace, who also developed a version of the theory, was influenced by similar patterns on islands around Malaysia and Indonesia. Today, many modern scientists use islands as laboratories for studying evolution.

Copy these questions into your notebook and answer in complete sentences:

1. **Why are the Hawaiian Islands considered hotspots?**
2. **How did there become so many species of fruit flies?**
3. **Define adaptive radiation.**
4. **Define biodiversity.**
5. **Why do scientists use islands as labratories for studying evolution?**