

A 'choose your own evolutionary pathway' – a brief exploration of the evolution and diversity of four major insect orders!

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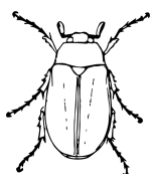
Imagine you are one of the very first insects to roam the earth, there are many habitats to explore and ecological niches to fill, but how will they be filled and why are the insect orders all so different?

1. You are an insect, roaming the earth millions of years ago, one day you return to your habitat and notice a lack of food for your offspring, do you:
 - a. Develop parasitic behaviour and lay your eggs inside other insects so your young will be born safely within the insect and have instant access to food? (Go to **section 2**).
 - b. Hope that there is enough food to go around. (Go to **section 3**).



2. Over the past c.350-309 million years you have developed into the order Hymenoptera – the sawflies, wasps, bees, and ants! Hymenoptera has c.157,388 described species, however the true number of species may be between 883,810 to 1.1 million! The success and large amount of diversity within Hymenoptera is partly down to their parasitism – many species lay their eggs inside other organisms (including inside other insects), meaning guaranteed food when they hatch! However, there were other behaviours which enabled even more diversification, for example the pollen feeding behaviours and herbivory of a broad range of plants by bees.

3. So far you have managed to find enough food for you and your offspring to eat, however a new problem arises. You notice other dangers: other animals keep stepping on you and your offspring. Do you:
 - a. Develop a sclerotised (hardened) forewing which serves to protect you under pressure and increase the number of habitats you can hide in? (Go to **section 4**).
 - b. Evade predation through flying (Go to **section 5**).



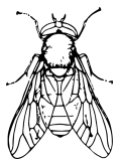
4. Over the past c.253 million years you have developed into the order Coleoptera – the beetles! The beetles have c.386,500 described species, however the true number of species may be between 1.7-2.1 million! Beetles are characterised by a sclerotised (hardened) forewing which can protect them from many different environmental stresses. This has allowed them to become a highly diverse order and to adapt and thrive in many different habitats such as in leaf litter, under bark, and many other habitats that would damage the delicate wings of other insects.

5. Predation is still a big issue for you! You can either disguise yourself and hide, or you can find a way to escape quickly! Do you:

- a. Develop camouflaging and predator alarming patterns on your wings? (Go to **section 6**).
- b. Develop nimble flight and large compound eyes to evade predation quickly? (Go to **section 7**).



6. Over the past c.245 million years you have developed into the order Lepidoptera – the butterflies and moths! Lepidoptera have c.157,424 described species, however the true number of species may be between 255,000-500,000! Lepidopterans wings serve as camouflage in many different environments, but some lepidopterans have brightly coloured wing patterns which can also alarm predators and scare them off. The patterning on the wings of different butterflies and moths can adapt quickly to new environments in some species (such as the peppered moth) and the different patterns are a key feature of the order.



7. Over the past c.267 million years you have developed into the order Diptera – the true flies! The flies have c.156,774 described species, however the true number of species may be between 400,000-800,000! The halteres - small club shaped organs behind the forewings - are gyroscopic and are what make the flies such nimble fliers. Their flight, coupled with their compound eyes allows for their effective escape from predators. The flies are an incredibly diverse order, with many species filling many different roles such as pollinators, decomposers/nutrient cyclers, parasites, pests, and vectors of disease.

A note on evolution

This 'pick your own' evolution is a very simplified version of the factors influencing and directing evolutionary pathways. In reality, the selective pressures acting on the evolution of species' is not controlled by any one factor but can be the result of multiple traits and behaviours which lead to the survival of the individual and thus the trait. As these traits accumulate over time, different species develop which are adapted to specific environments or niches and leads to highly diverse groups of insects such as the orders described above. Hopefully this exercise has inspired you to consider some of the ways in which different species have adapted and the reasons why certain traits – whether behavioural or physical – have come to be.

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