

A1 INTRODUCTION

Key Notes

What is a plant?

Flowering plants are by far the most important plants and this book is primarily a study of them. The most fundamental dividing line between living organisms is that between prokaryote and eukaryote cells. Within the eukaryotes there are three main multicellular kingdoms, plants, animals and fungi, and a heterogeneous, mainly unicellular, kingdom Protista. We include here only plants and some plant-like Protista.

Unifying features of plants

Plants are photosynthetic and autotrophic (with very few exceptions), have chlorophyll *a* and *b* except for some algae, have a cellulose cell wall and a cell vacuole, and have an alternation of diploid and haploid generations. Vegetative structure is similar across most vascular plants; reproductive structures differ.

What is a plant?

The science of plant biology is primarily the study of **flowering plants** or **angiosperms**. Flowering plants are by far the most important group of plants in the world, providing the overwhelming majority of plant species (over 250 000 in all) and most of the biomass on land, and they are the basis for nearly all our food. This book is mainly about flowering plants.

Historically, the science of **plant biology**, or **botany**, has included all living organisms except animals, but it is clear that there is a major division of life between cells with a simple level of organization, the **prokaryotes**, and those with much more complex cells, the **eukaryotes**. The prokaryotes include bacteria and bacteria-like organisms and will not be considered further in this book except in relation to plants, although some retain plant-like names, such as referring to the gut ‘flora’ for the bacteria in mammalian guts, and ‘blue-green algae’ for the **cyanobacteria**. Among eukaryotes three main multicellular kingdoms are recognized: **animals**, **plants** and **fungi**. There is a fourth heterogeneous group of eukaryotes that are mainly unicellular but with a few multicellular groups such as **slime molds** and large **algae**. Some of these have affinity with animals, some with plants, some with fungi and some have no obvious affinity. They are grouped together, for convenience, as a kingdom, the **protists**, **Protista** (or Protoctista).

There is no clear boundary between protists and plants, and authors differ in which organisms they consider in which kingdom. Multicellular **green algae** and, to a lesser extent **brown** and **red algae**, have many features in common with land plants and are the dominant photosynthetic organisms in shallow seas. Unicellular planktonic groups form the basis of the food chain in the deep sea. All these algae are photosynthetic, like plants, and share some characters. They are considered in this book for comparison with other plants in Section P. Other protists, animals and fungi will not be considered further except in relation to plants. Plant groups other than flowering plants, such as mosses, ferns and conifers, differ in various ways and these are considered in Sections P, Q and R.

Unifying features of plants

To characterize the features that define plants as different from other eukaryotes is almost impossible since every feature has exceptions, but usually these exceptions are among plants that have lost the feature or are among the algae on the boundary between protists and plants.

- They are **photosynthetic** and obtain all their nutrients from inorganic sources, i.e. they are **autotrophic** and the start of a food chain. Many protists, particularly among the plankton, are also photosynthetic. A few plants derive all or part of their nutrients from other organisms (Topics M6, M7) but these are closely related to other, photosynthetic, flowering plants.
- The photosynthetic pigment is **chlorophyll**, and in all plants except some algae, there are two forms, *a* and *b*, contained within chloroplasts.
- The cells have a **cell wall** made predominantly of the polysaccharide **cellulose**, and a **vacuole** in addition to the **cytoplasm**.
- There is an **alternation of** diploid and haploid **generations** (Topic P1). Often one of these is much reduced and may not live independently.

Vegetative structure and physiology is similar throughout the seed plants (flowering plants, conifers and some smaller groups) and there are many similarities with other vascular plants as well, but the reproductive structures differ markedly. Larger algae and bryophytes differ more fundamentally in vegetative and reproductive structure (Section P).