With about 250,000 known species, the angiosperms are by far the most diverse and widespread group of land plants.

As primary producers, flowering plants are at the base of the food web of nearly every terrestrial ecosystem.

Primary vs. secondary production?

Most land animals, including humans, depend on plants directly or indirectly for sustenance.
2. Plants have three basic organs: roots, stems, and leaves. They interact.

- The plant body is a hierarchy of structural levels, with emergent properties arising from the ordered arrangement and interactions of component parts.
- The plant body consists of organs that are composed of different tissues, and these tissues are teams of different cell types.
- Xylem, for example, is a tissue. It consists of two cell types – tracheids and vessel elements.
Fig. 35.2

Flower
Terminal bud (shoot apex)
Node
Internode
Axillary bud
Terminal bud of branch
Vegetative branch
Leaf
Petiole
Blade
Stem
Taproot
Lateral roots

Shoot system
Root system
• Both systems depend on the other.
  • Lacking chloroplasts and living in the dark, roots would starve without the sugar and other organic nutrients imported from the photosynthetic tissues of the shoot system.
  • Conversely, the shoot system (and its reproductive tissues, flowers) depends on water and minerals absorbed from the soil by the roots.
• Most absorption of water and minerals in both systems occurs near the root tips, where vast numbers of tiny **root hairs** increase the surface area enormously.

• Root hairs are extensions of individual epidermal cells on the root surface.

• Let’s watch some video about roots and shoots!

![Fig. 35.3](image-url)
• Some plants have leaves that have become adapted by evolution for functions other than photosynthesis. Homology, yes?

• This includes tendrils to cling to supports, spines of cacti for defense, leaves modified for water storage, and brightly colored leaves that attract pollinators.
• Vascular tissue, continuous throughout the plant, is involved in the transport of materials between roots and shoots.

• Xylem conveys water and dissolved minerals upward from roots into the shoots.

• Phloem transports food made in mature leaves to the roots and to nonphotosynthetic parts of the shoot system.
Fig. 35.8

(a) Tracheids

(b) Vessel elements with partially perforated end walls

(c) Tracheids and vessels (colorized SEM)

Vessel element

Vessel

Tracheids

100 μm
Both tracheids and vessels have secondary walls interrupted by pits, thinner regions where only primary walls are present. Both are dead at maturity. They die by APOPTOSIS.

The ends are perforated, enabling water to flow freely, a great example of how structure is related to function.
In the phloem, sucrose, other organic compounds, and some mineral ions move through tubes formed by chains of cells called **sieve-tube members**.

- They are alive at functional maturity, although they lack a nucleus, ribosomes, and a distinct vacuole.
- The end walls, the **sieve plates**, have pores that facilitate the flow of fluid between cells.
- A nonconducting nucleated **companion cell**, connected to the sieve-tube member, may assist the sieve-tube cell.
- Each sieve tube cell and its companion cell originated from the mitosis of the same cell.
• A major difference between plant and most animals is that the growth and development of plants is not just limited to an embryonic or juvenile period, but occurs throughout the life of the plant.

• At any given instant, a typical plant consists of embryonic organs, developing organs, and mature organs.

• So STEM CELLS are found and are active in plants to a much greater degree than in animals.
A plant is capable of continual growth because it has perpetually embryonic tissues called **meristem** in its regions of growth. These are like animal stem cells, but aren’t called that.

These cells divide to generate additional cells, some of which remain in the meristematic region while others become specialized and incorporated into the tissues and organs of the growing plant.
The pattern of plant growth depends on the location of meristems.
Fig. 35.19
Let’s relate structure to function in leaves...

- Upper epidermis: one cell thin makes it transparent. Because it is transparent it lets light through to the photosynthesizing cells beneath.

- Cuticle: because it is made of cutin, a hydrophobic wax, it prevents water loss from the leaf (and stems). Because it is thin, it is relatively transparent, it lets light in for photosynthesis.

- Lower epidermis: contains guard cells, which can form a space (stomata) between them for CO$_2$ to pass in and O$_2$ to pass out. CO$_2$ is needed for which part of photosynthesis? They also play a role in water transport.
• Stomata are also the major avenue of evaporative water loss from the plant - a process called transpiration.
• This cools them off, just like it does you and I.