What are Adaptations?

An adaptation is defined as anything that helps an organism survive and successfully reproduce in an ecosystem. It is important to remember that mere survival is not enough for evolution to occur; you must also reproduce to be considered successful as an organism. Therefore adaptations can be divided into two general categories: functional adaptations, which are adaptations that help an organism survive in its environment, and reproductive adaptations, which are adaptations that help an organism successfully reproduce. An organism must have both functional and reproductive adaptations in order to ensure that its genes are carried on into the next generation. The following are some examples of functional and reproductive adaptations in plants:

Functional Adaptations
A functional adaptation is any adaptation that helps an organism survive. For plants, this means anything that helps them carry out major life functions; like photosynthesis, water and nutrient storage and transport, and growth. Some examples of these kinds of adaptations from the plant kingdom include:

- *Adaptations for water-limited environments* – Many plants live in a water-limited environment. This means they live in places where water is scarce or hard to come by, like in a desert. In order for a plant to survive in such an environment it must have adaptations to help it cope with the lack of water. Many xerophytes (desert and arid plants) have evolved ways to capture and store water. During the rare times when it rains in the desert, they can take up as much water as possible and store some for later. Cacti, many palms, agaves and euphorbs (cactus-like desert plants) do this. These plants will store water in their stems, leaves or trunks. We call these “succulent” stems or leaves. Many of these plants also keep their stomata closed during the day to prevent too much water loss in the hot dry sun and open them instead at night.

![Cactus plant with succulent stems](image-url)
Many orchids and bromeliads have ways to capture and store water as well. Such orchids and bromeliads often grow in tropical rainforests, so why do they need to store water if there is plenty of rain? These plants live on the bark of other trees, thus they do not have access to the wet soil and need ways to capture and store water for themselves when it rains.

- **Adaptations for light-limited environments** – Some plants live a light-limited environment. That means that light is very scarce or hard to come by. This occurs in the understory of most dense forests, since very little light gets through the forest canopy. If you are a plant on the floor of a thick forest, you may not receive very much light during the day. Thus many plants that grow in thick tropical rainforests have adaptations that allow them to obtain more or better utilize light so they can maximize photosynthesis. Many plants have adaptations for climbing. In this way they can climb up closer to the top of the canopy where there is more light. Such plants include vines and lianas (woody vines). Epiphytes like orchids and bromeliads have adapted to live in canopy trees where there is more light. Plants that spend their lives on the forest floor may have dark green leaves with red undersides. This coloration helps them capture the most light that they can from the shady forest floor. The dark green indicates an abundance of chlorophyll and the red serves to reflect light back into the leaf so it is not lost. If you hold one of these leaves up to the light, you will notice that very little light gets through. Many of these plants are so well adapted to dim light that they do not do well if exposed to full sunlight. Other plants have adapted to remain small for long periods of time, then to grow quickly when a canopy tree falls and lets more light through.

Epiphytes, like this orchid, live in the treetops where there is more light than on the forest floor

- **Supportive adaptations** – plants have numerous structural adaptations for support. These are the easiest adaptations to observe. For instance, some tropical trees have buttress roots, which are roots that come out from the lower part of the trunk and grow into the ground, providing support for the tree. Prop roots are another supportive root structure that you may know from looking at red mangroves. Some trees grow in very unstable soil, and the complex prop root system helps keep the tree stable in an unstable environment. Epiphytes and vines also have special roots that help them grab onto a tree’s bark and stay put.
Various supportive root adaptations

- **Defensive Adaptations**: Plants also need to be able to defend themselves against predators in order to survive. Therefore, defensive adaptations also fall in this category of functional adaptation. Plants have evolved ways to defend themselves. Cellulose makes them hard to digest. The presence of sharp spines, thorns or hairs or creation of toxic chemicals can also deter herbivory.

_Mimicry_ is another unusual way some plants have evolved to defend themselves. Certain plants have evolved to look like another plant that is poisonous. Animals are fooled into believing that these similar-looking, but harmless plants are also poisonous. Thus the plant is less likely to be eaten and does not have to waste energy producing a poison or other defense mechanism. It makes sense that through natural selection, those plants that look more like real poisonous plants would survive to pass on their genes while other, dissimilar looking plants would be eaten. This is how mimicry occurs. Note that some animals use mimicry as well. For instance there are some flies that have evolved to look exactly like bees, but they have no sting!
Reproductive Adaptations
You are a plant that has all the appropriate adaptations to survive and defend yourself in your environment, is that enough to ensure survival of your species? Not really, now you must also reproduce! Plants that have flowers (angiosperms) have many adaptations that allow them to successfully reproduce. We learned all about pollination syndromes (see Flower Power course pack) and how flowers have evolved different smells, shapes, colors and sizes in order to attract certain pollinators. We also know that some plants depend on wind pollination and often have small unimpressive flowers since they do not need to attract a pollinator. In addition to pollination syndromes, flowers have developed a number of other adaptations to help them reproduce successfully and prevent self-fertilization. These are some other reproductive adaptations and strategies not covered in flower power:

- **Annual strategy** - Some plants grow quickly within one year, produce lots and lots of seeds all at once and then die. We call these plants annuals. Many of our crops, like corn and wheat, are annuals. Annuals are almost always herbs. Because they live short lives, they do not have time to invest in making wood, but simply grow as much as possible in a year then reproduce and die. The benefit to this is that a plant is able to invest all its energy into reproduction, because it is investing minimal energy into long-term survival.

- **Perennial strategy** – other plants will live for years and years, reproducing over many seasons. These plants generally have fewer seeds per season than annual plants, but they reproduce many times over their lifespan. Perennials can be trees, shrubs or herbs.

Annual strategy: corn, wheat and other grains make a lot of seeds at once, and then die
Perennial strategy: this plant produces a few flowers and fruits every season

- *Preventing self-fertilization* - flowers have a number of adaptations to limit self-fertilization or “selfing”. Some flowers are self-incompatible, meaning that the female part (carpel) will not accept its pollen. Other flowers are dioecious (having separate male and female individuals) which makes selfing impossible. Some are monoecious (having separate male and female flowers on the same plant) and their male and female flowers will mature at different times. Some flowers will make their stigma receptive to pollen only after all of its pollen has been shed. Some flowers keep their stamens and carpel at a distance from each other, for instance the carpel may be very tall and the stamens may be short, making it harder for the flower to pollinate itself.