Reproduction with Cones and Flowers

Remember that **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are very well adapted to life on land – they don’t need **\_\_\_\_\_\_\_\_\_\_\_\_** for fertilization as ferns and mosses and other seedless plants do. Having seeds and either **\_\_\_\_\_\_\_\_\_\_\_\_** or **\_\_\_\_\_\_\_\_\_\_\_** allows gymnosperms and angiosperms to reproduce almost anywhere.

Alternation of Generations

In seed plants, the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and recognizable form of the plant is the diploid **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. The gametophyte in a seed plant is found **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** the **\_\_\_\_\_\_\_\_\_\_\_\_\_** of gymnosperms and inside the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of angiosperms.

Life Cycle of Gymnosperms

Reproduction in Gymnosperms takes place in **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** produced by the mature sporophyte.

**Pollen Cones & Seed Cones**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** gametes are produced in **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (also called male cones). These pollen cones produce the male gametophytes, which are called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** – this is the entire male gametophyte generation.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_** gametophytes are produced in **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**; which are the larger cones we are familiar with. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are produces at the bottom of each \_\_\_\_\_\_\_\_\_\_\_\_\_ of the cone, and the female gametophytes develop inside these ovules. When mature, each female gametophyte contains a few **\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, each of which can be fertilized by a sperm nucleus from the pollen.

**Pollination**

* In spring, male pollen cones produce huge numbers of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* Pollen is carried by the **\_\_\_\_\_\_\_\_\_\_\_\_\_**, and some will reach female cones, where they get stuck to a **\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**) on the scales. Pollination drop helps to ensure that the pollen **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** on the female cone so fertilization can occur.

**Fertilization & Development**

* Pollen grain lands near an **\_\_\_\_\_\_\_\_\_\_\_\_\_**, the pollen grain splits open and produces a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + Pollen tube contains 2 haploid **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + When it reaches the female gametophyte, 1 sperm nuclei **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** it, and the other sperm nuclei disintegrates
    - If a sperm from a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** pollen tube reaches the female gametophyte, more than 1 egg can be fertilized, but **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** will develop into an embryo.
  + At fertilization, a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is formed – this is the first cell of a new **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  plant
    - Zygote divides by mitosis to develop into an embryo
  + The seed starts to form; it has made up of tissues from a combination of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
    - The outer seed coat is from the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** generation
    - The embryo is the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** generation
    - Between these is a layer of haploid cells from the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Structure of a Flower

We think of flowers as decoration, but really, they are the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of angiosperms.

**Sepals and Petals**

* Sepals are the small, usually green, **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** structures that cover the **\_\_\_\_\_\_\_\_\_\_\_** before it opens and protect the flower when it is developing.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are found just inside the sepals, and they are modified leaves which are usually brightly **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to attract **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.

**Stamens and Carpels**

Moving inward from the petals, we come to the structures that **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** the gametophytes.

* The male structure is the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, which is made up of two parts:
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** – a long thin **\_\_\_\_\_\_\_\_\_\_** that supports the anther
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** – an oval sac at the top of the filament, this is where **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** occurs to produce the haploid male gametophytes (**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**).
    - If you touch a flower, you may get yellow-gold **\_\_\_\_\_\_\_\_\_\_\_\_** on your fingers – this is **\_\_\_\_\_\_\_\_\_\_\_\_\_**, made up of thousands of individual pollen grains.
  + Most flowers contain **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** stamens
* The female part is found in the middle of the flower, and is called the **\_\_\_\_\_\_\_\_\_\_\_\_** (or the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_**).   
  Parts of the carpel:
  + **\_\_\_\_\_\_\_\_\_\_\_\_** – the broad base of the carpel, it contains the **ovules**, where the female gametophytes are produced.
  + **\_\_\_\_\_\_\_\_\_\_\_** – the narrow **\_\_\_\_\_\_\_\_\_\_\_\_** that forms the upper portion of the carpel
  + **\_\_\_\_\_\_\_\_\_\_\_** – the sticky portion at the top of the style, where **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** land

Some flowers have multiple carpels **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** together into a compound carpel.

* Most plants have flowers that produce **\_\_\_\_\_\_\_\_\_\_** the **\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** gametophytes.
* However, in some plants the two types of gametophytes are produced in **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** on the same individual
* In some plants many flowers grow together into a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + Example: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Life Cycle of Angiosperms

Reproduction in angiosperms occurs within the **\_\_\_\_\_\_\_\_\_\_\_\_\_**. After pollination and fertilization, the **\_\_\_\_\_\_\_\_** develop inside **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** structures.

* The mature sporophyte produces **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. In most cases, each flower contains both **\_\_\_\_\_\_\_\_\_\_\_\_\_** and an **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + In the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, the haploid **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are produced meiosis, which each develop into a male gametophyte (**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**)
    - The pollen grain develops a hard wall to protect it from **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
    - The nucleus of the pollen grain goes through **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** once to produce two haploid **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
    - The pollen grain **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** until it is deposited on a stigma
  + The female gametophyte is produced in the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, which are contained in the ovary.
    - A diploid cell undergoes **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to produce 4 haploid cells. Only 1 survives, and it then goes through mitosis to produce eight nuclei in a single membrane, called the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
      * This embryo sac is the female **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
      * One of the nuclei becomes the egg nucleus – the female **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + If fertilized, this egg will form part of the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** that will grow into the new sporophyte plant
    - The embryo cells begin to differentiate, developing into specialized cells as part of the **\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** or **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

Pollination

Now that the male and female gametophytes have been produced, it is time for pollination to occur.

* Where **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are pollinated by the **\_\_\_\_\_\_\_\_\_\_\_**, most **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are pollinated by **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,** and only a few angiosperms use wind pollination.
* Pollinators are animals that **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** from one flower to another; most pollinators are **\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, **\_\_\_\_\_\_\_\_\_\_\_\_**, and **\_\_\_\_\_\_\_\_\_\_\_\_\_**
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is much more **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** than wind pollination (A great example of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**)
  + Wind pollinated plants must produce **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of pollen, and depend on **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** for pollination to occur 🡪 lots of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** pollen
  + Animal pollinated plants have many **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to improve the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of pollination
    - Brightly **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to advertise to pollinators
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to reward pollinators
    - Some have specific **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** or behaviours depending on their main pollinator species
      * A “**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**” for insects
      * **\_\_\_\_\_\_\_\_\_\_\_\_** corollas for hummingbirds
      * Blooming **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** for bats

🡪 Insect pollination may be the factor that is mostly responsible for angiosperms \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gymnosperms over the last 100 million years!

* + What’s in it for the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**?
    - Provides a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ source of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** for the pollinator   
      🡪 **\_\_\_\_\_\_\_\_\_\_\_\_**, **\_\_\_\_\_\_\_\_\_\_\_\_**, or both

Fertilization in Angiosperms

* A pollen grain lands of the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of a flower of the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, and begins to grow a pollen tube.
* The pollen tube grows down **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, and all the way to the **\_\_\_\_\_\_\_\_\_\_\_\_\_** and into the **\_\_\_\_\_\_\_\_\_\_\_\_**.
  + The pollen tube contains two sperm nuclei, and then **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** take place
    - 1 sperm nucleus fuses with the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to produce the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
    - The other sperm nucleus fuses with **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (extra **\_\_\_\_\_\_\_\_\_** that are produced by meiosis when the egg nucleus is formed), to form a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (3N) cell
      * This triploid cell will grow into the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** storage tissue which provides nourishment to the embryo and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** as it grows
    - This process is known as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
      * Thought to be one of the reasons that angiosperms have been so successful
        + In **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** the food reserve is built up **\_\_\_\_\_\_\_\_\_\_\_\_\_** fertilization   
          🡪 if fertilization doesn’t occur, the food in that ovule is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**!
        + Angiosperms are more **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, since food isn’t stored for the seed until fertilization has **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**🡪 **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** food.

Seed Development and Germination

Seed & Fruit Development

Once fertilization has occurred, the parent plant sends **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to the flower to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** development of the **\_\_\_\_\_\_\_\_\_\_**.

In Angiosperms, the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** thicken and form a **\_\_\_\_\_\_\_\_\_\_\_\_** around the developing **\_\_\_\_\_\_\_\_\_\_\_**. Parts of the **ovule** become tougher and form the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (outer protective layer of the seed, enclosing the embryo and the food supply). The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** thickens and may join with parts of the stem, to form the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of the **\_\_\_\_\_\_\_\_\_\_\_\_**.

* Biologically speaking a **\_\_\_\_\_\_\_\_\_\_** is any **\_\_\_\_\_\_\_\_\_\_\_\_\_** that is enclosed within the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** wall.
  + Examples: **\_\_\_\_\_\_\_\_\_\_\_\_**, grapes, peas, **\_\_\_\_\_\_\_\_\_\_**, **\_\_\_\_\_\_\_\_\_\_\_\_**, **\_\_\_\_\_\_\_**, tomatoes
* There is a wide variety of types of fruits
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** tissues: **\_\_\_\_\_\_\_\_\_\_\_\_**, tomatoes
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** tissues: **\_\_\_\_\_\_\_\_\_\_\_** pods
  + Inner wall of ovary **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of the seed: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, cherries
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** in an aerodynamic shape: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Seed Dispersal

The purpose of the fruit is to aid in seed dispersal

**Dispersal by Animals**

* Seeds with (usually) **\_\_\_\_\_\_\_\_\_\_\_\_**, fleshy fruits are intended to be **\_\_\_\_\_\_\_\_\_\_\_** by animals
  + These seeds usually have a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to protect the seed from the harsh **\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** in the digestive tract of the animals
  + Then the seeds are deposited in another distant **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, in a patch of the animal’s feces, which provide a natural **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + The sweet, nutritious fruits provide an important **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** for animals, and the animals help \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the seeds longer distances than the plants could manage on their own

🡪 Another example of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Dispersal by Wind and Water**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** seeds are specialized to be dispersed by wind or water
  + Wind:
    - Ash and maple seeds have **\_\_\_\_\_\_\_\_\_\_\_**
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** break off at their roots and tumble along the ground, **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** their seeds as they go.
  + Water:
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are a large seed filled with the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** endosperm (the coconut milk), which helps it to be buoyant enough to **\_\_\_\_\_\_\_\_\_\_\_\_** in seawater for up to weeks
      * This has allowed coconuts to spread to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** effectively

Seed Dormancy

* Some seeds germinate almost \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when they land in a suitable location
* However many seeds enter a period of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (where the embryo is alive but **\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**), from a few days to weeks, years or even decades.
  + The oldest known seed that was still able to germinate was over **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** old!

**Benefits of Dormancy**

* Long-term dormancy can allow for **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** dispersal (such as coconuts floating to a new island)
* Can allow seeds to germinate under **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (such as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** instead of summer or winter, or when **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is reduced)

**Ending Dormancy**

* Environmental factors such as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** can trigger a seed to **\_\_\_\_\_\_\_\_\_** dormancy and germinate
* Some plants (such as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** pines and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** pines) have a **\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** on their seed cones, and require the high temperatures of a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to open – this ensures that the seeds will have very little **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** when they germinate.

Seed Germination

Germination is the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of a plant embryo

* Seeds **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + This water causes the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ tissues to **\_\_\_\_\_\_\_\_\_\_\_\_**, cracking the **\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_** open
* Young **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** through this crack and starts to grow
* Development of the shoot varies
  + In most **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, the single cotyledon (seed leaf) stays **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, and the new shoot emerges, protected by a sheath
  + In **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, there are 2 main possibilities
    - The **\_\_\_\_\_\_\_\_** cotyledons can **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** above ground and protect the stem and the first foliage leaves
      * The cotyledons will then either **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and drop off, or become **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (pumpkin)
    - The cotyledons can stay **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, and provide a **\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** for the new seedling

Plant Propagation & Agriculture

Asexual Reproduction

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** reproduction is any type of reproduction that involves **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* All offspring from asexual reproduction are **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to the parent and to each other. These identical offspring are sometimes called **\_\_\_\_\_\_\_\_\_\_\_\_\_**.

**Advantages**

* One **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of asexual reproduction is that many offspring can be produced very **\_\_\_\_\_\_\_\_\_\_\_\_\_**, creating a large population.
* When the environment is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, genetic variability is not very important, so this can be a very successful **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.

**Disadvantages**

* The main **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is that any factor that negatively affects the parent will also impact **\_\_\_\_\_\_** of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the same way.
* This means that a single environmental **\_\_\_\_\_\_\_\_\_\_\_\_\_** or a new drug or disease can wipe out the \_\_\_\_\_\_\_\_\_\_\_ **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** very easily.

Vegetative Reproduction

* The asexual production of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** offspring (clones) from the parent plant, without the formation of a **\_\_\_\_\_\_\_\_\_\_**. Since it does not require pollination or seed formation, it allows plants to reproduce **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
* Different plants have can use **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of vegetative reproduction, including stolons, plantlets, and rhizomes.
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are long, trailing **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** stems (commonly called **\_\_\_\_\_\_\_\_\_\_\_\_**), which produce **\_\_\_\_\_\_\_\_\_\_\_\_\_** when they touch the ground. Once these new roots are established, a new plant starts to grow, and the stolon can be broken, creating a completely **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** new plant.
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are a great example of this.
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are tiny new plants that form at the ends of elongated stems, **\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to touch the ground. If these plantlets **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and fall to the ground, or something happens to the parent plant, they can **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and form a whole new plant.
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  are very well known for producing multiple plantlets
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_** that can send up multiple **\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** from beneath the soil.
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are a good example of this – the whole forest can be a group of clones of the same original bamboo plant.

Plant Propagation for Human Use

* When a plant has traits that are particularly desirable, often gardeners and horticulturalists will want to make more plants with the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* However simply breeding the plant normally (**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** reproduction through pollination) produces additional **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**; which may interfere with the desired trait.
* Additionally, some food crops have been specifically bred to produce **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. These plants **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** sexually through pollination and seed production, so gardeners must intervene.
* In both of these cases, **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** techniques are used to produce new plants through **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** reproduction.

**Cuttings**

* The simplest way to propagate a plant is using **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* The gardener cuts a length of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** including **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (with their meristematic tissue), and then “plants” the cutting into **\_\_\_\_\_\_\_\_\_\_\_\_**.
* Some plants produce **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** easily in this setting, while others (particularly **\_\_\_\_\_\_\_\_\_\_\_\_** plants) often require the addition of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.

**Grafting and Budding**

* Generally used to reproduce **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** varieties of plants, and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** plants that have a harder time producing roots.
* A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (or a lateral bud) is cut from the parent plant and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to another plant. The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of the two plants must be firmly **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to each other, or it will not work.
* This procedure is generally most **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** if performed when plants are **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** – wounds can heal before growth begins.
* The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is called the **\_\_\_\_\_\_\_\_\_\_\_\_** and the plant it is attached to is called the **\_\_\_\_\_\_\_\_\_\_\_\_**. When the scion is a **\_\_\_\_\_\_\_\_\_\_**, this procedure is known as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. When the scion is a **\_\_\_\_\_\_\_**, it is known as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* This technique can be used to grow **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** flower or fruit on the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** or bush
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** trees
  + Can help preserve **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** species

**Plant Tissue Cultures**

* Plant **\_\_\_\_\_\_\_\_\_\_\_\_** can be placed in a petri dish with nutrients and grow into **\_\_\_\_\_\_\_\_\_\_\_** individuals.
* Once they have developed into a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, they can be transplanted into soil and then continue to grow **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* This can be used to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** endangered species of plants, or to clone plants for use in **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.

Agriculture

When humans started **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** for their own use, it caused major changes to human society. Later, as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** visited other parts of the world, food crops were **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and transported back home. In fact, many of the foods we associate with a particular country, were actually **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** from somewhere else relatively recently.

* Great plains are the “breadbasket” of North America – **\_\_\_\_\_\_\_\_\_\_\_** originated in the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* Tomato sauce is a key part of Italian food – **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** originated in **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* Potatoes are key to German and Irish food – **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are also from **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* Rice is now included in Mexican foods such a burritos – **\_\_\_\_\_\_\_\_\_\_** originated in **\_\_\_\_\_\_\_\_\_\_\_\_\_**, spread to Europe, and then was introduced to Mexico by the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Today **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of plants (mostly **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**) are used as food crops around the world. However relatively **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, are used to provide **\_\_\_\_\_\_\_\_\_\_** of the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (for humans and livestock) around the world. For example, in the US over **\_\_\_\_\_\_\_\_\_\_\_** of the cropland is used for growing **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.

Interestingly 3 of these (wheat, corn, and hay) are modified types of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. This is an example of how **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (even by accident) can have major effects on plants and on humans.