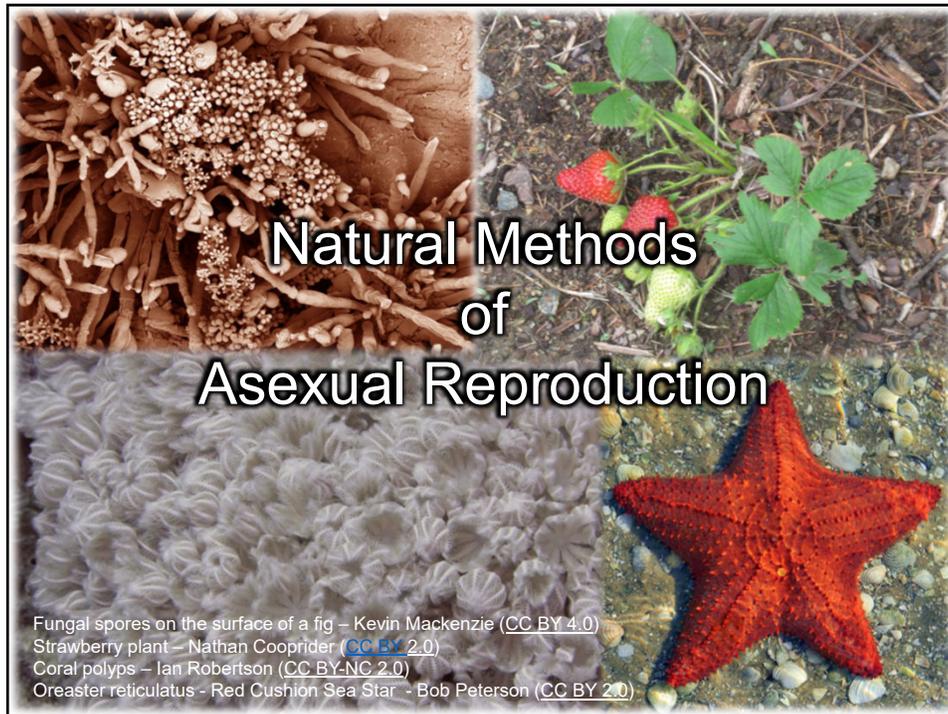


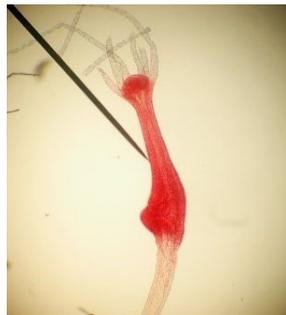
## Asexual Reproduction

- Asexual reproduction is reproduction that occurs without any interaction between two different members of a species.
- Offspring are genetically identical to the parent.
- Organisms produced by asexual reproduction are the product of **mitosis**.

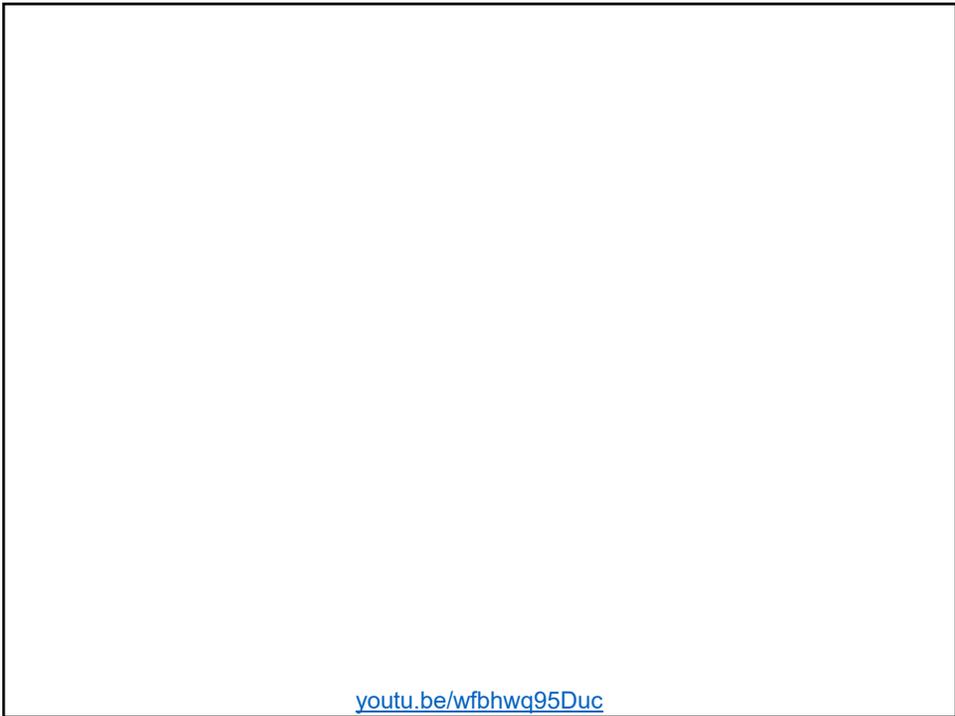
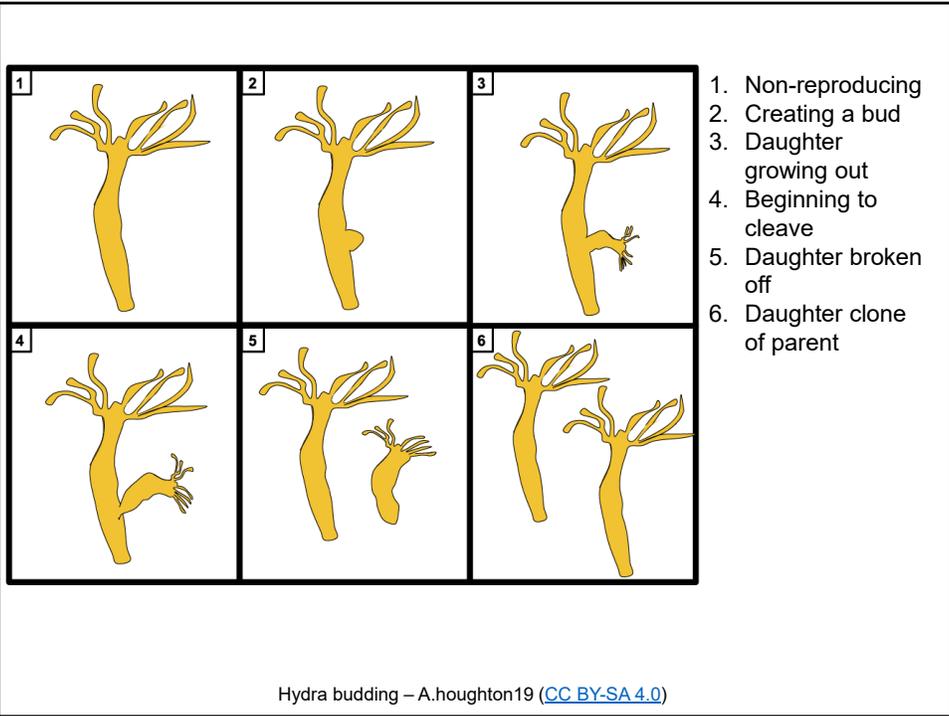


## Budding

- Offspring grows out of the body of the parent, then breaks off into a new individual.
  - Usually restricted to certain specialized areas.



Hydra – Becky Boon (CC BY-SA 2.0)



## Vegetative Propagation

- A plant growing a new shoot which is capable of becoming a whole new organism.



Strawberry and Quackgrass – Aldona (Adobe Stock Image)

## Fragmentation

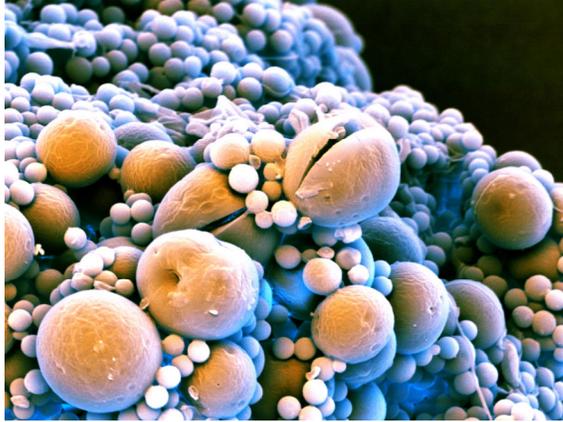
- A “parent” organism is split into multiple parts, each of which grows to become a complete, independent “offspring” organism.
- A special type of fragmentation is called regeneration.



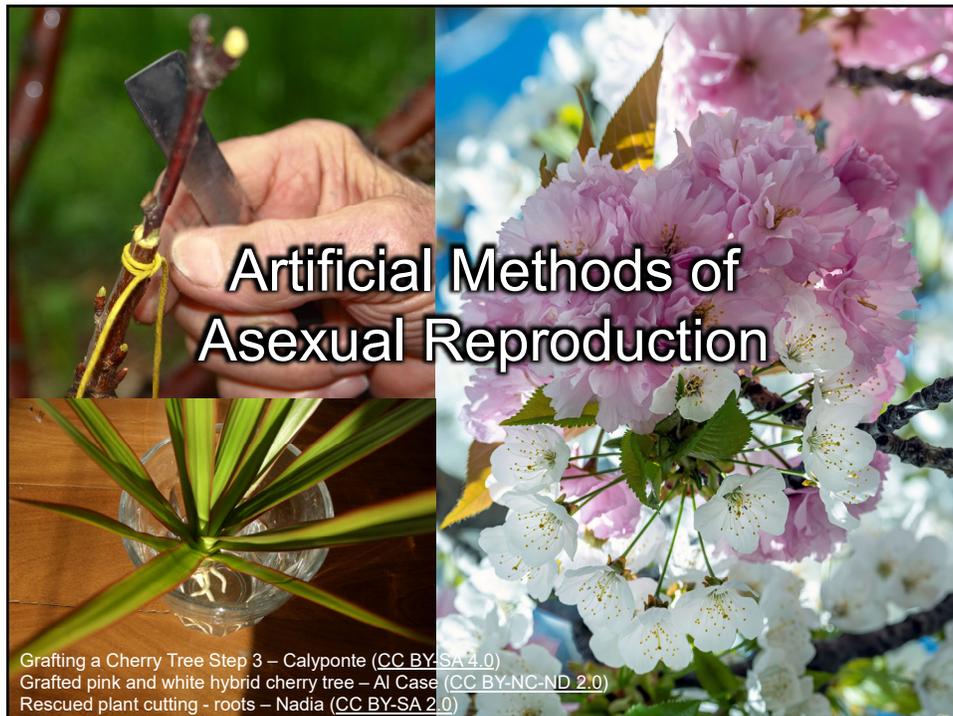
sea star – NOAA Ocean Exploration & Research ([CC BY-SA 2.0](https://creativecommons.org/licenses/by-sa/2.0/))

# Spores

- Structures grown as part of an organism's life cycle and designed for separation from the organism.
  - Dispersed via air or water



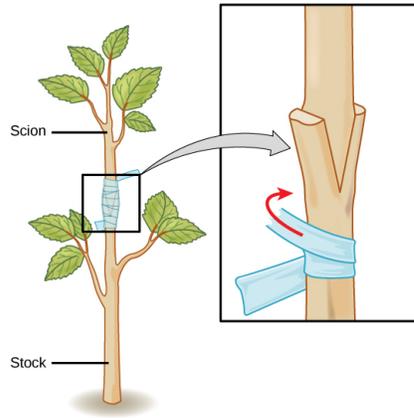
Fungal spores - ZEISS Microscopy  
([CC BY-NC-ND 2.0](https://creativecommons.org/licenses/by-nc-nd/2.0/))



Grafting a Cherry Tree Step 3 – Calyponte ([CC BY-SA 4.0](https://creativecommons.org/licenses/by-sa/4.0/))  
Grafted pink and white hybrid cherry tree – Al Case ([CC BY-NC-ND 2.0](https://creativecommons.org/licenses/by-nc-nd/2.0/))  
Rescued plant cutting - roots – Nadia ([CC BY-SA 2.0](https://creativecommons.org/licenses/by-sa/2.0/))

# Grafting

- Part of the stem of the desirable plant (scion) is grafted onto a rooted plant (the stock).
- Both are cut at an oblique angle, placed in close contact with each other, and are then held together.



Grafting – Biology, OpenStax, Rice University.  
[openstax.org/books/biology/pages/32-3-asexual-reproduction](https://openstax.org/books/biology/pages/32-3-asexual-reproduction)  
(CC BY 4.0)

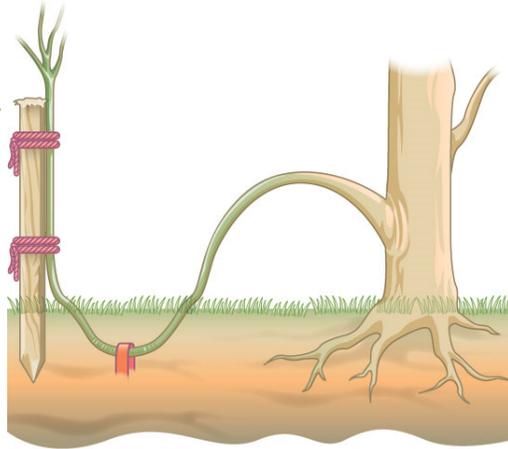
- The vascular systems of the two plants grow and fuse, forming a graft.
- The scion will eventually produce shoots, bearing flowers and fruits.
  - Widely used in viticulture (grape growing) and the citrus industry.
    - Scions capable of producing a particular fruit variety are grafted onto root stock with specific resistance to disease.



Grape Vines - Cliff Lede Winery - Jill Clardy (CC BY-SA 2.0)

## Layering

- A stem attached to the plant is bent and covered with soil
  - Young stems that can be bent easily any injury are preferred
  - Jasmine can be propagated this way



Layering – modification of work by Pearson Scott Foresman, donated to the Wikimedia Foundation. Biology. OpenStax, Rice University. [openstax.org/books/biology/pages/32-3-asexual-reproduction](https://openstax.org/books/biology/pages/32-3-asexual-reproduction) (CC BY 4.0)

## Cuttings

- A portion of the stem containing nodes and internodes is placed in moist soil and allowed to root.
  - In some species, stems can start producing a root even when placed only in water.
    - Example: African violet



Purple African Violet Top – Jjhake (CC BY-SA 3.0)

## Advantages

- Rapid population growth
  - a population can be rebuilt from just a single individual in a matter of days in some bacteria
- No mate is needed to reproduce
  - useful for species whose members are isolated
- Lower resource investment
  - fewer resources are needed if not nurturing a new baby organism

- Positive genetic influences are guaranteed to be passed to the next generation.
  - allows for quick adaptation to new environmental issues

## Disadvantages

- Lack of diversity
  - susceptible to the same diseases, nutrition deficits, and other types of environmental hardships
- Negative mutations linger longer
  - offspring guaranteed to carry the mutated genes

- Pest resistance is minimal
  - Plants that are grown through an asexual reproductive cycle tend to be less likely to resist pests that may be within the environment

## Sexual Reproduction

- Sexual reproduction involves two parents.
- Parents produce reproductive cells (**gametes**) that unite to form an offspring.
- Gametes are **haploid** cells produced through **meiosis**.
- Sexual reproduction starts with the **gametes** (sperm and egg) combining in a process called **fertilization**.

## External Fertilization

- The sperm fertilizes the egg cell outside the female's body.
  - Reproductive process includes spawning.



Kokanee in red – Roger Tabor, USFWS ([CC BY-NC 2.0](#))



Spawning Horseshoe Crabs, Slaughter Beach, Delaware Bay 3 – Paul Williams ([CC BY-NC 2.0](#))

## Internal Fertilization

- The sperm fertilizes the egg cell inside the female's body.
- After the egg is fertilized, there are three possibilities.
  - The egg is laid outside the female's body and develop there, receiving nourishment from the yolk.



Friends – Andrei! ([CC BY-SA 2.0](#))

- The egg is retained in the female and the embryo obtains its nourishment from the egg's yolk.
  - The young are fully developed when they are hatched.



*Thamnophis sirtalis sirtalis* (Eastern Garter Snake) – Wilson44691 (public domain)

- The young develop within the female and receive nourishment from the mother's blood through a placenta.
  - The offspring develops in the female and is born alive.



Newborns 0022 (kitten) – Rocky Mountain Feline Rescue ([CC BY 2.0](#))

## Advantages

- Produces genetic variation in the offspring.
  - crossing over, randomized arrangement, random fertilization process
- Species can adapt to new environment.
  - survival advantage
- A disease is less likely to affect all the individuals in a population.
  - immune traits are influenced by genes ([www.nature.com/articles/ncomms13850](http://www.nature.com/articles/ncomms13850))

## Disadvantages

- Reproduction cannot occur until and unless gametes from both parents fuse together.
  - There is no guarantee that the nucleus of the male gamete will fuse with the female gamete after mating.
- Only half of the population (female) are capable of gestation
  - fertility is also limited to certain times

- The time taken to produce an offspring by sexual reproduction is very long.

<b>Animal</b>	<b>Average Gestation Period (days)</b>
Mouse	19
Rabbit	31
Dog	61
Cat	64
Tiger	109
Human	270
Cow	286
Giraffe	430
African Elephant	645