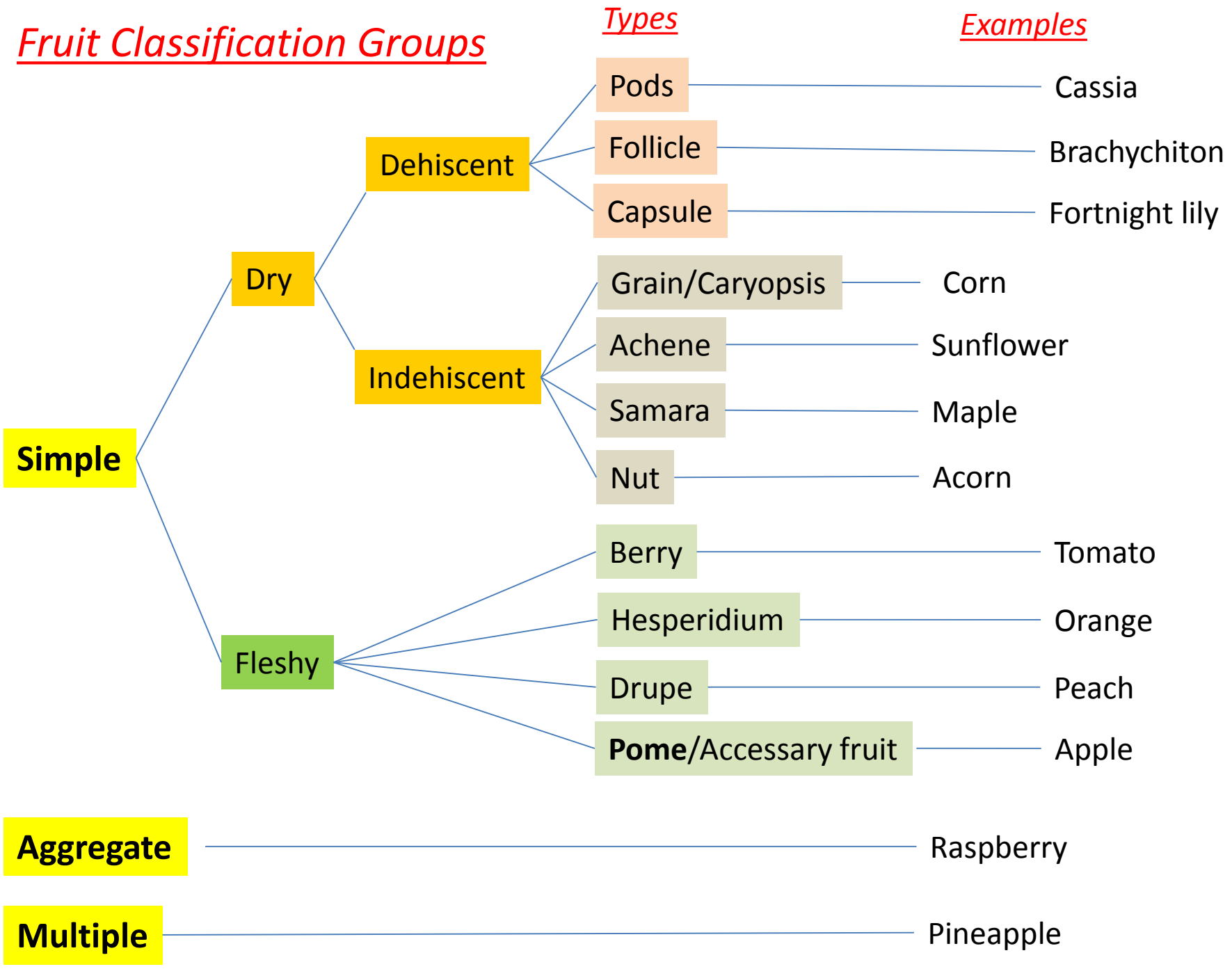
Fruits

And their classification

Terms

- Seed
- Simple Fruit
- Aggregate fruit
- Multiple fruit
- Pericarp
- Testa
- Endosperm
- Dehiscent
- Indehiscent
- Pome
- Hesperidium
- Parthenocarpic
- Hypanthium
- Pod
- Achene
- Grain
- Capsule
- Caryopsis
- Folicle
- Exocarp (Epicarp)
- Mezocarp
- Endocarp
- Berry
- Drupe
- Cauliflorous
- Parthenocarpic fruits

Fruit Classification Groups



What is a Fruit?

- A fruit is a mature ovary with a seed or seeds inside
- The Ovary Wall develops into the pericarp of the fruit
- That pericarp can separate out into 3 different layers that compose the structure of the fruit

Typical Parts of a Fruit

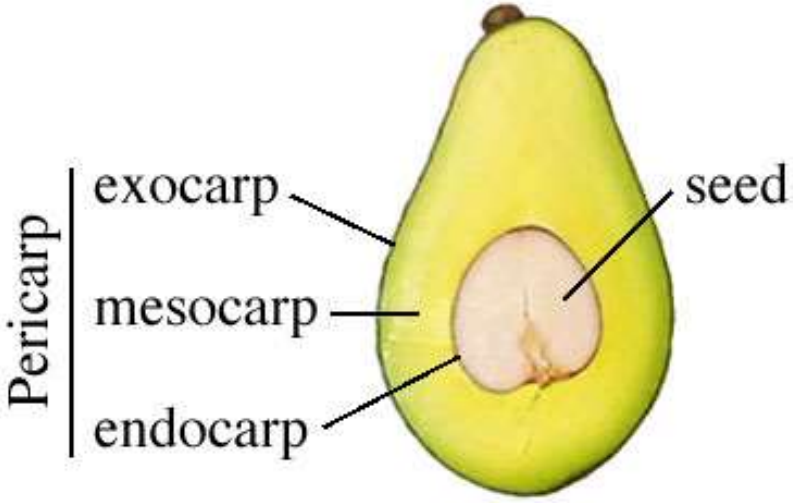
The **Pericarp** is typically made up of three distinct layers:

1. the **epicarp**, which is the outermost layer
2. the **mesocarp**, which is the middle layer
3. the **endocarp**, which is the inner layer surrounding the ovary or the seeds. *Ex: In a citrus fruit, the epicarp and mesocarp make up the peel.*

Fruit Classification

- The flower type on the plant determines he fruit type.
- Most fruit types (especially fleshy fruits) are classified by groups using similarities of the 3 parts of the Pericarp.

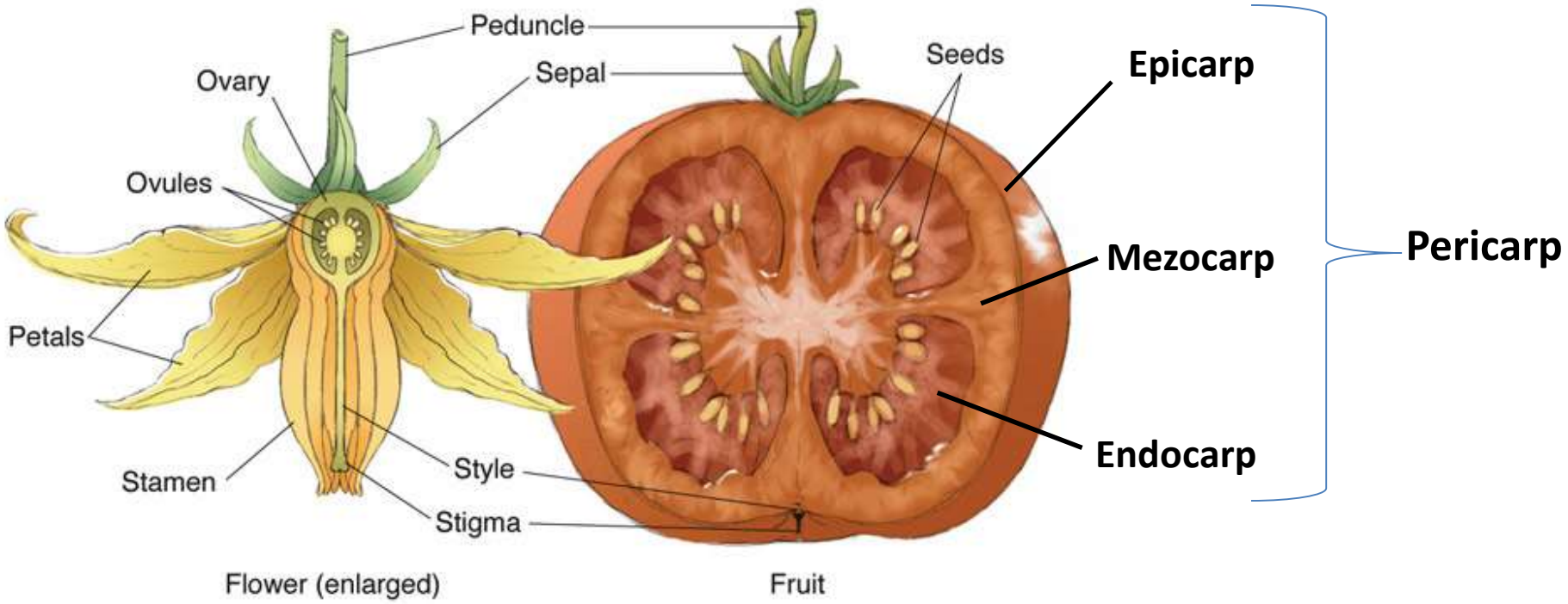
- Exocarp
- Mesocarp
- Endocarp



Avocado

From Flower to Fruit - Tomato

The tomato flower is an example of having a single ovary with several ovules that will eventually develop into seeds

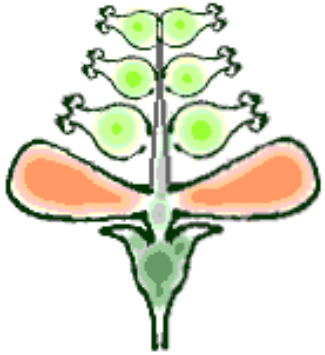


3 Main Classifications of Fruit

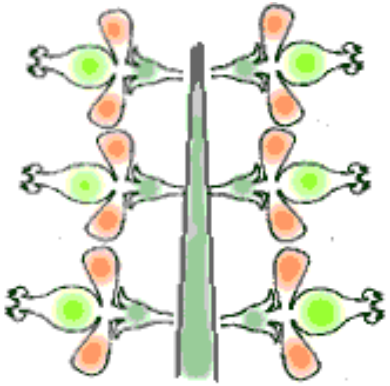
The flower configuration determines the fruit type

Simple - One ovary one flower

simple



aggregate



multiple

Multiple- flowers on one inflorescence

Simple

Aggregate - Multiple ovaries on one flower

Aggregate

Multiple

Simple Fruits

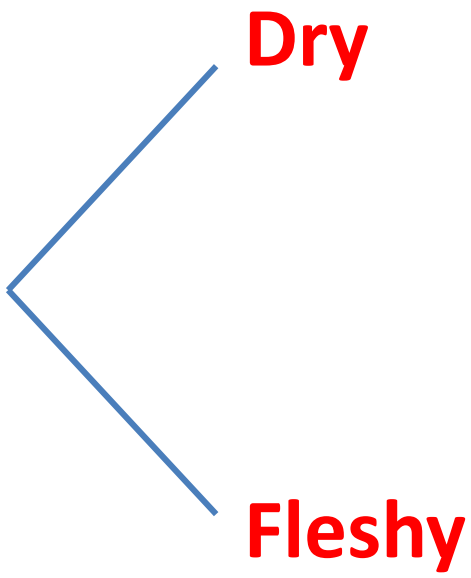
- A simple fruit develops from a flower with one ovary

- This one ovary can have one or multiple compartments inside

Simple Fruits

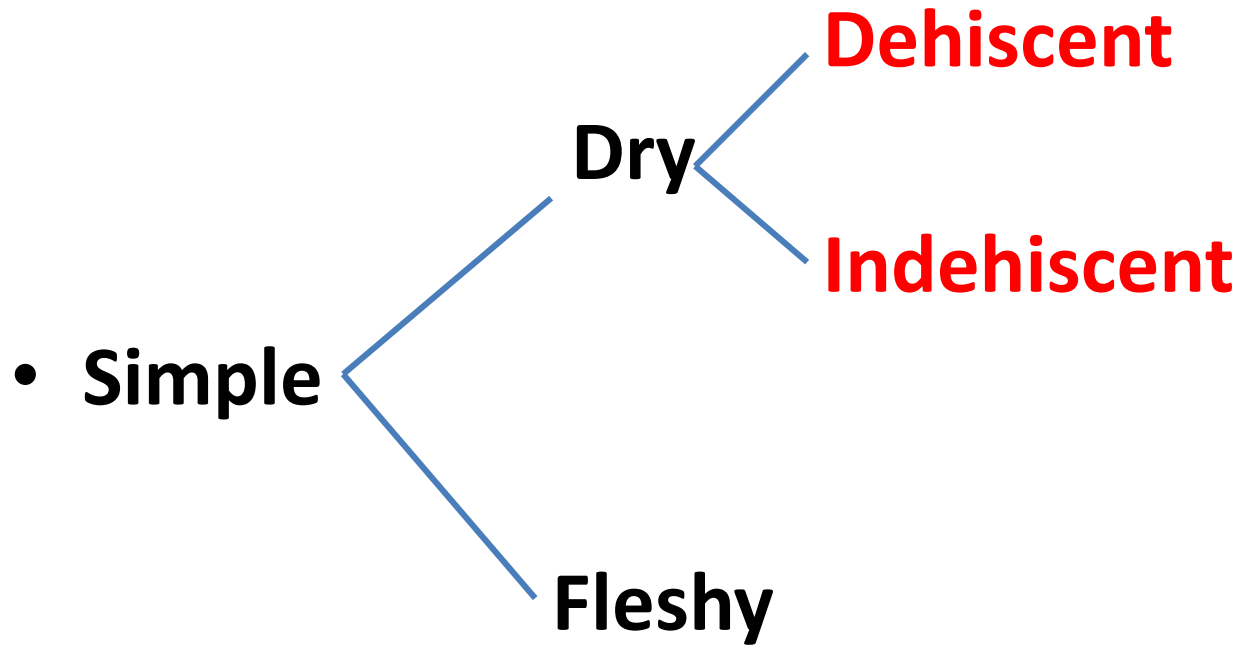
- Simple Fruits can be either Dry or Fleshy

- Simple Fruits



Simple Dry Fruits

- Simple, Dry Fruits can be dehiscent or indehiscent (Dehiscent means to split (open) at maturity)



Simple, Dry, Dehiscent Fruits

- **Pods** – One compartment, Usually many seeds, Splits along two places
- **Follicle** – One compartment, usually many seeds, splits along one seam
- **Grain/Caryopsis –** One seed, Pericarp fused with testa
- **Capsule -** More than one compartment in ovary and it splits along each compartment

Pod

-One compartment
-Many seeds
-Splits in 2 places

Cassia leptophylla
(Gold medallion tree) **seed pods**

Wisteria seed pods

Follicle

- Splits along one seam

Milkweed follicle and seeds

***Brachychiton populenus* = classic Follicles**

Capsule

- More than one compartment in ovary
- Split at each compartment

Open cotton capsule

4 compartments

Ripening cotton capsule

Capsule

Dietes capsules

Ceiba speciosa

Capsules

Aristolochia capsule

Cape chestnut capsule with seed still inside

Simple Dry **Indehiscent** Fruits

- Single ovary
- Do not split at seams

Achene

Samara

Nut

Achene

- One seeded
- Papery pericarp
- Pericarp can be removed

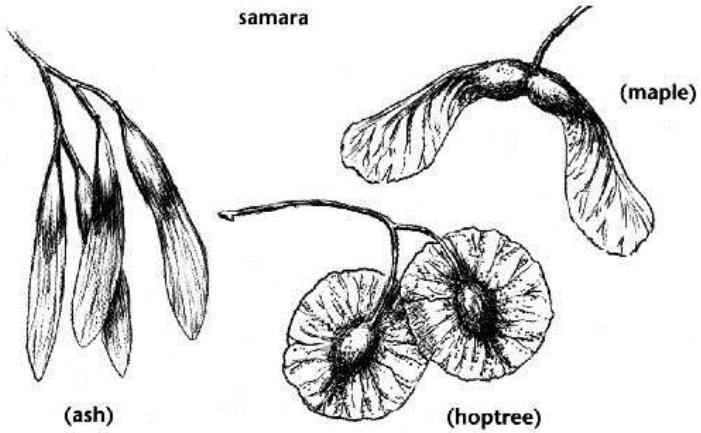
Strawberry

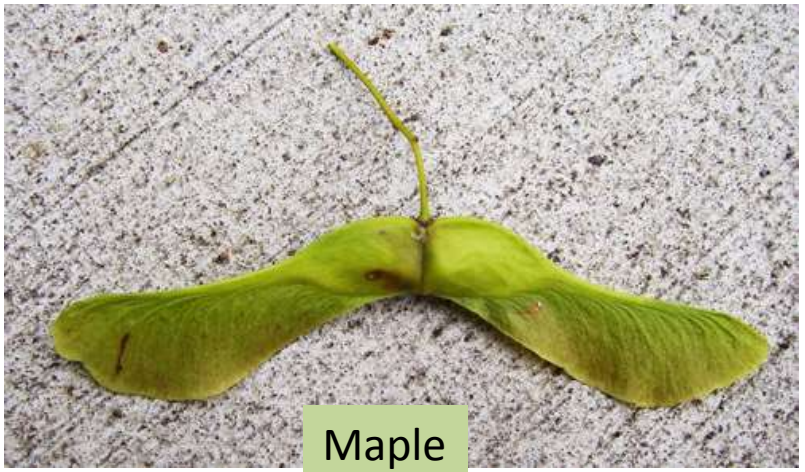
Dandelion seed

Sunflower

Achene - Dandilyon

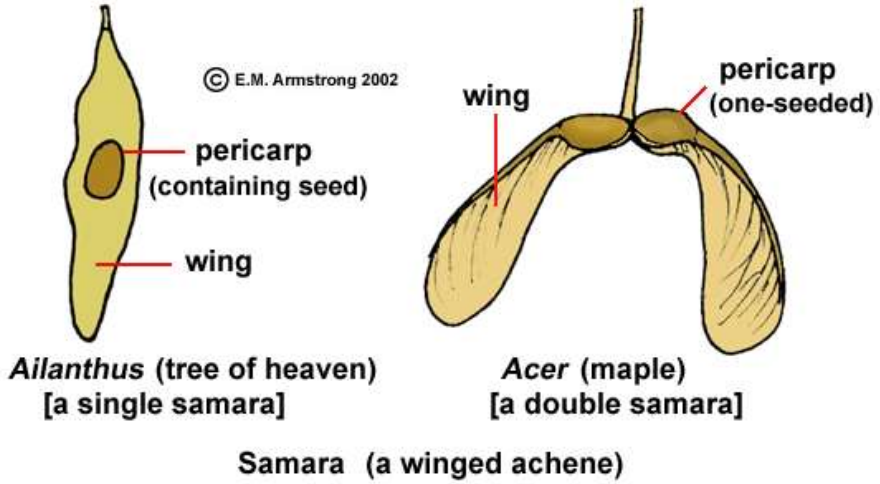
Samara (a winged Achene)





Maple

Ash Samara



Samara (a winged achene)

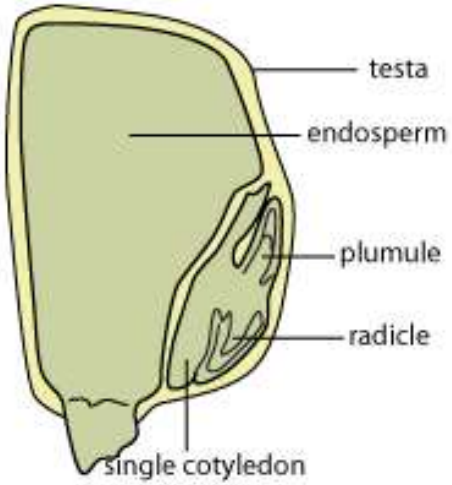
Samara

Hopseed bush

Big leaf Maple – Trinity college, Dublin

Grain/Caryopsis

- One seed
- Pericarp fused with testa (Seed coat)



Nut

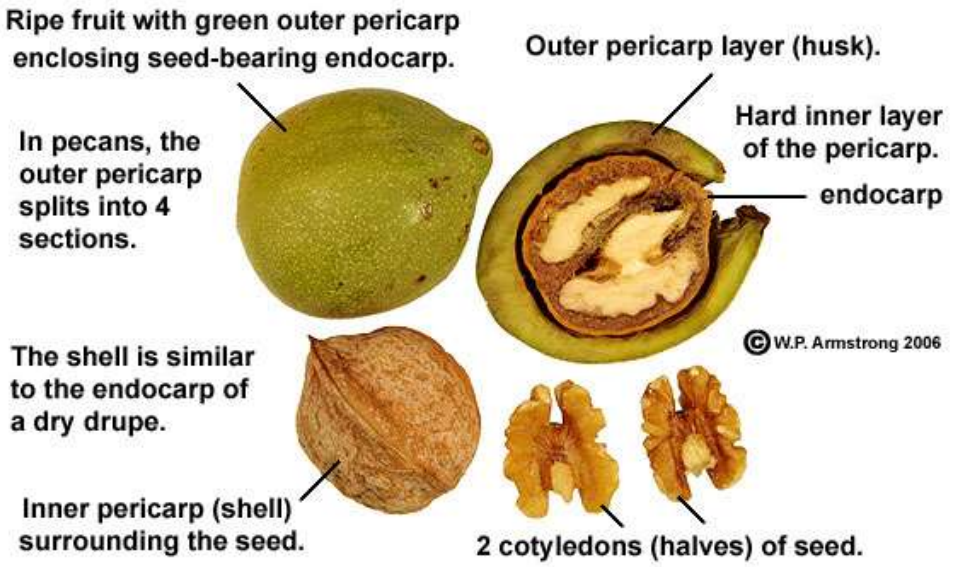
Pecan

Walnut

Acorn

- One seeded fruit
- Woody **pericarp**

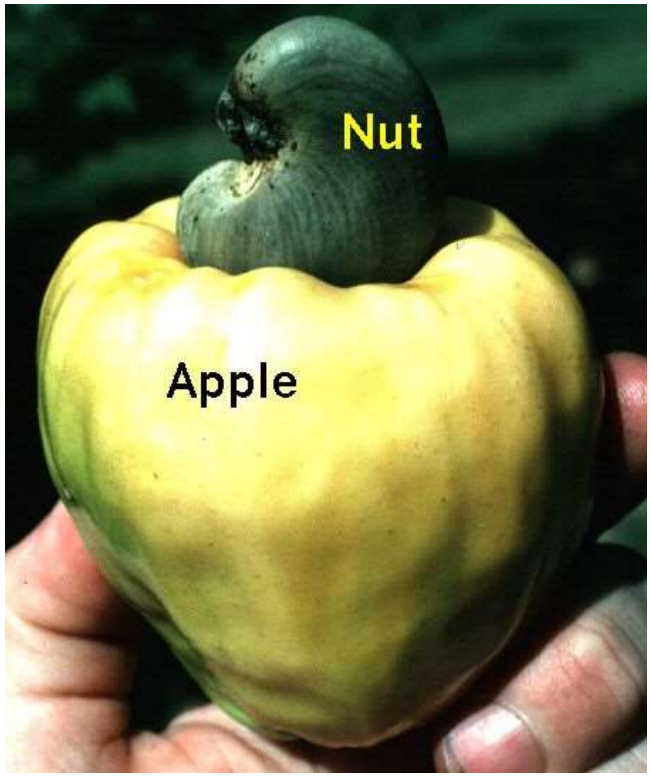
Hazelnut



Cashew

The cashew fruit is considered a **False Fruit** since the seed develops outside the ovary. Cashews are not true nuts (surrounded by a woody pericarp), but the seed we eat is surrounded by a soft leathery lining filled with a poisonous fluid that is released when carefully dried or roasted.

https://www.youtube.com/watch?v=xdMjW3W6SAY



Nut Confusion

- **Whole (Unshelled) Peanuts** are **Pods**
- **Coconuts** are **Drupes**
- **Unshelled Almonds** are **Drupes**
- **Brazil nuts** are **Seeds**
- **Unshelled Pistachios** are **Drupes**

Why so much confusion? Most of the structure of taxonomic classification occurred earliest in temperate climates that did not recognize the many tropical variations we see commonly today

Brazil nuts (seeds)

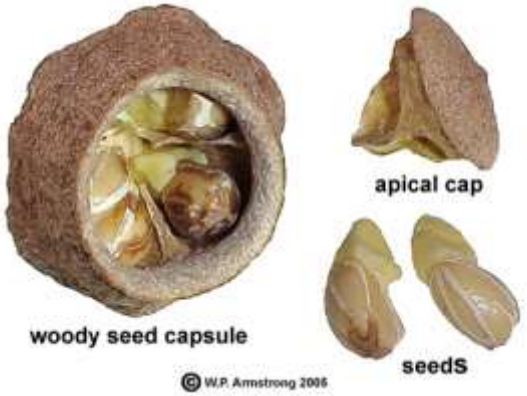
Once we see where a Brazil Nut comes from we realize that the hard "Nut" we crack open is actually a seed inside a much larger woody seed capsule.

seeds (Brazil nuts)

woody seed capsule
Upper half has been cut away.

The Brazil “Nut” Seed

Seed capsule Developing seeds



The Aguti is a rodent that is able to open the “Brazil nut“ Seed using it as a major food source

Almonds (Drups)

Drupe:

- One seed
- **Pericarp** in 3 layers
- **Exocarp** skin
- **Mezocarp** fleshy
- **Endocarp** woody

Almond flowers

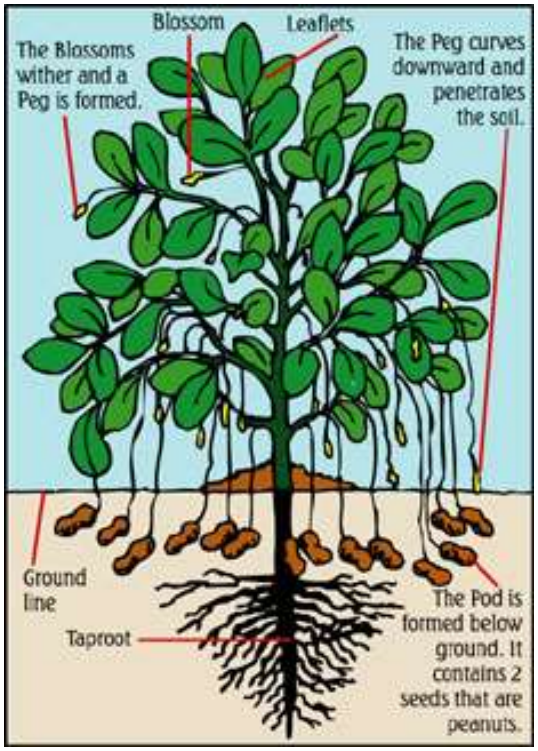
Woody endocarp

Seed

Almond drupe showing all 3 layers of the pericarp.

https://www.youtube.com/watch?v=zmUYead-uZw

Peanuts (pods)



-**Pods:**

-**One compartment**

-**Many seeds**

-**Splits in 2 places**

Simple – Fleshy Fruits

- Berry
- Hesperidium
- Drupe
- Pome
- Accessory fruits

In Fleshy fruits the **Pericarp** is usually divided into 3 separate layers that have varying characteristics depending on the type of fruit. They are the:

Exocarp (epicarp)

Mezocarp

Endocarp

Berry

Papaya

Simple fruit
Fleshy pericarp
- One or more compartments
- **Exocarp** – a thin skin
- Both **mezocarp** and **endocarp** are fleshy

Pepper

Avocado

Berry

Grapes

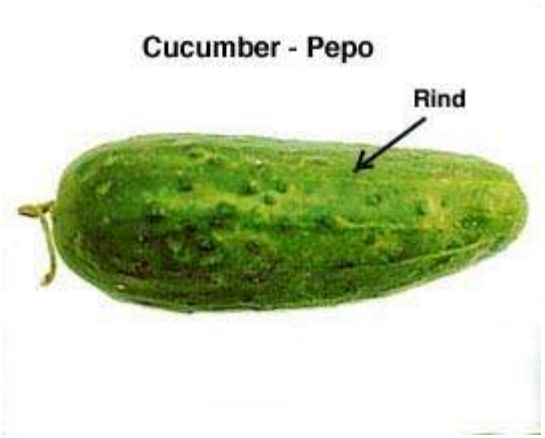
Dates

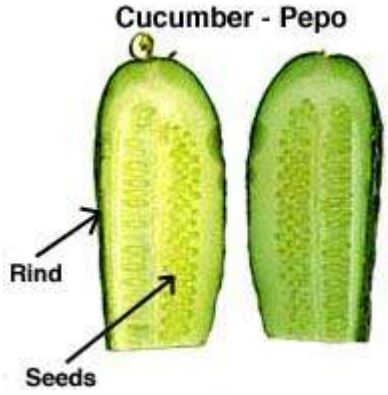
Eggplant

Tomato

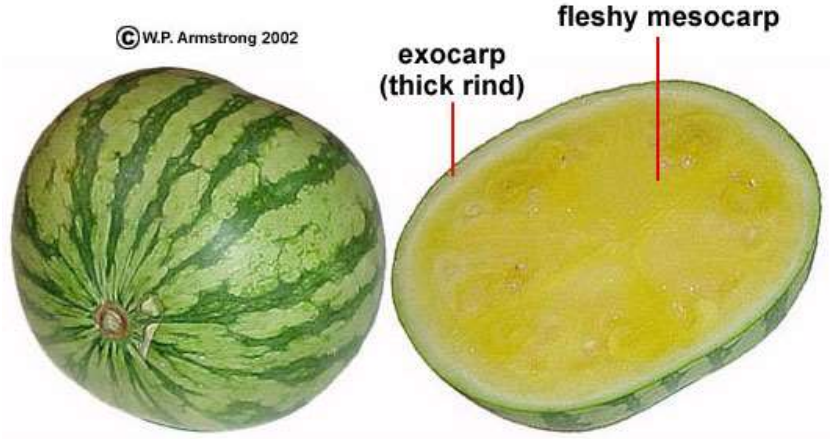
Persimmon

Pepo

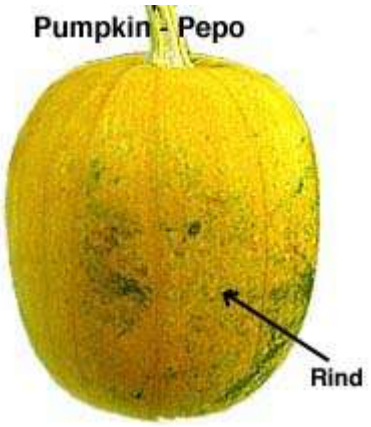




Pepo - a **berry** with a *hard outer rind*, typical of cucurbits such as cucumbers and melons

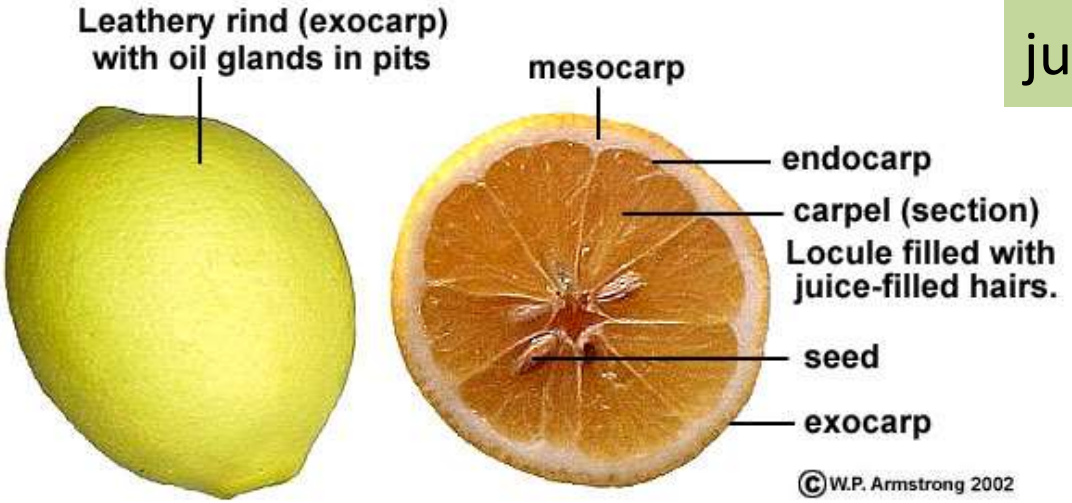


Pepo (a berry with a hard, thick rind)
e.g. watermelon (*Citrullus lanatus* var. *lanatus*)



Hesperidium

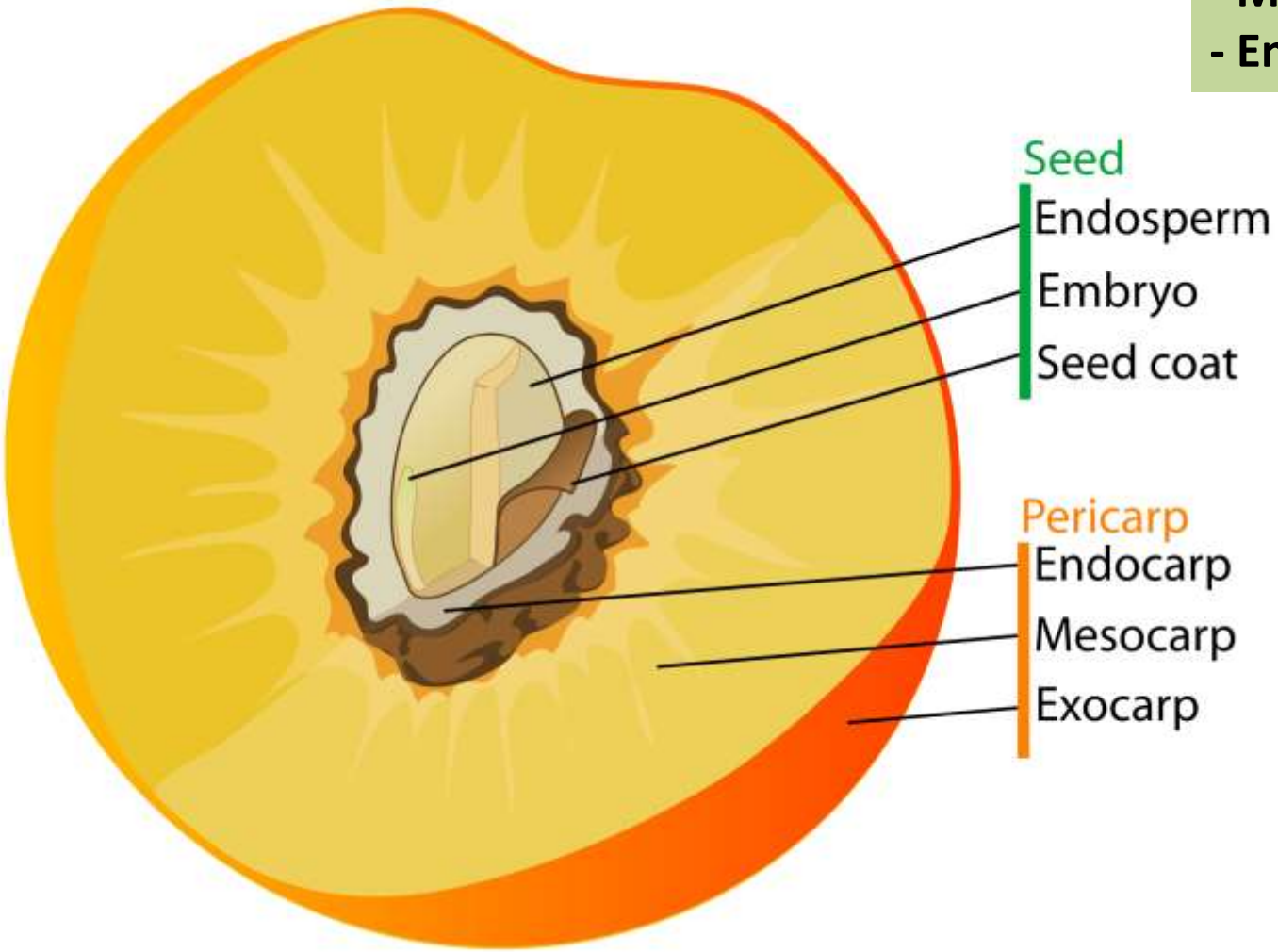
A **hesperidium** is a berry with a leathery rind (**exocarp**)
The **mezocarp** is the whitish spongy material usually attached to the rind. The **endocarp** is the segmented juicy sections



Hesperidium (berry with a leathery rind)
e.g. lemon (*Citrus lemon*)

Drupe

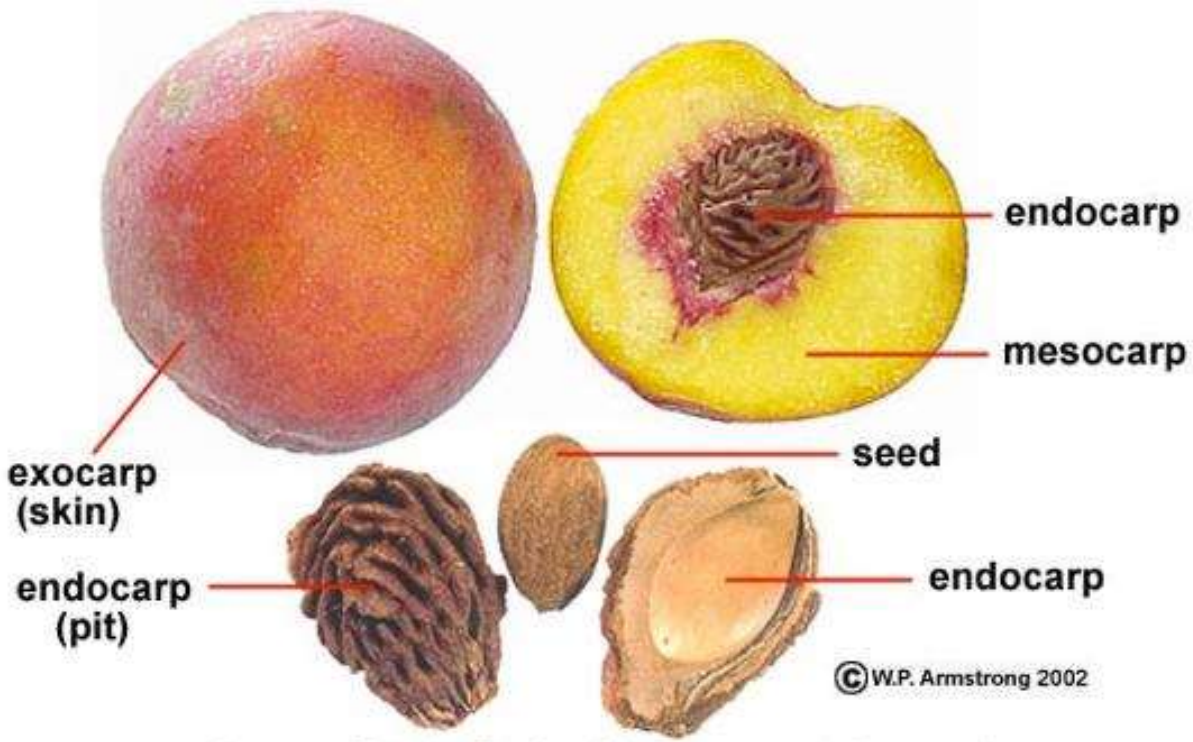
- One seed
- **Pericarp** in 3 layers
-**Exocarp** skin
- **Mezocarp** fleshy
- **Endocarp** woody



Drupes

Plums, apricots, nectarines

Cherries

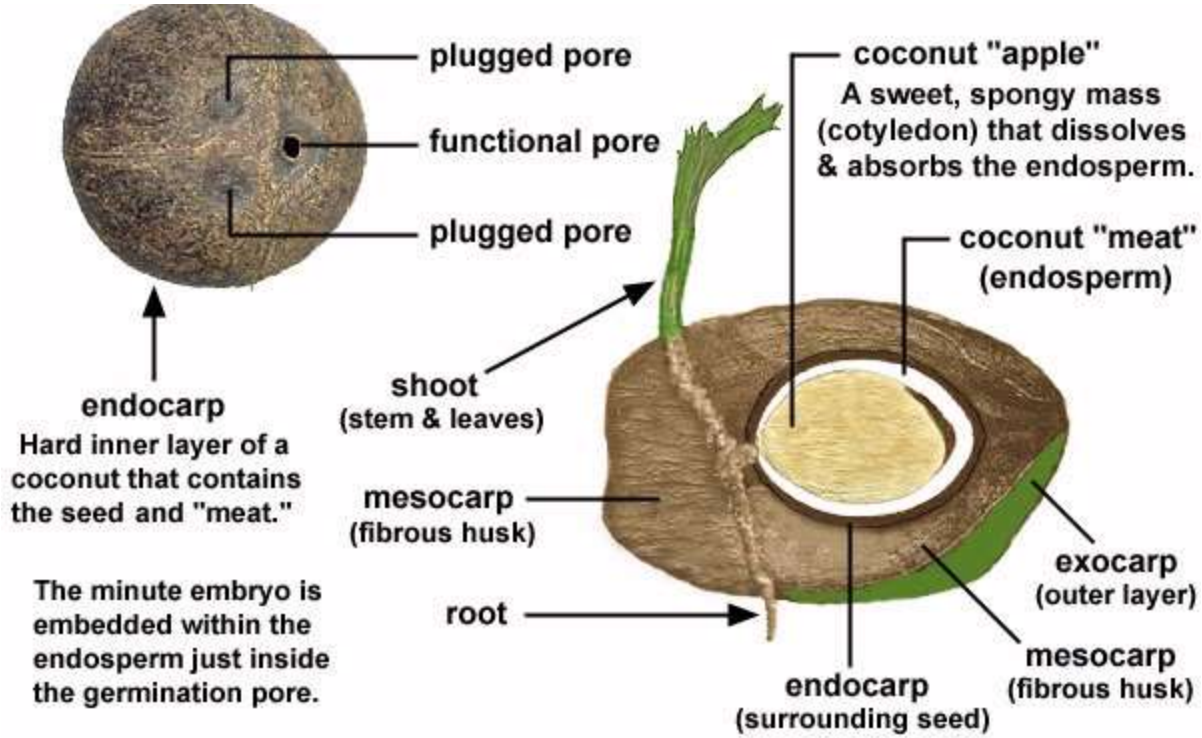


Drupe (fleshy fruit with a stony endocarp)

A Different Drupe

https://www.youtube.com/watch?v=En2hZmp1Pcg

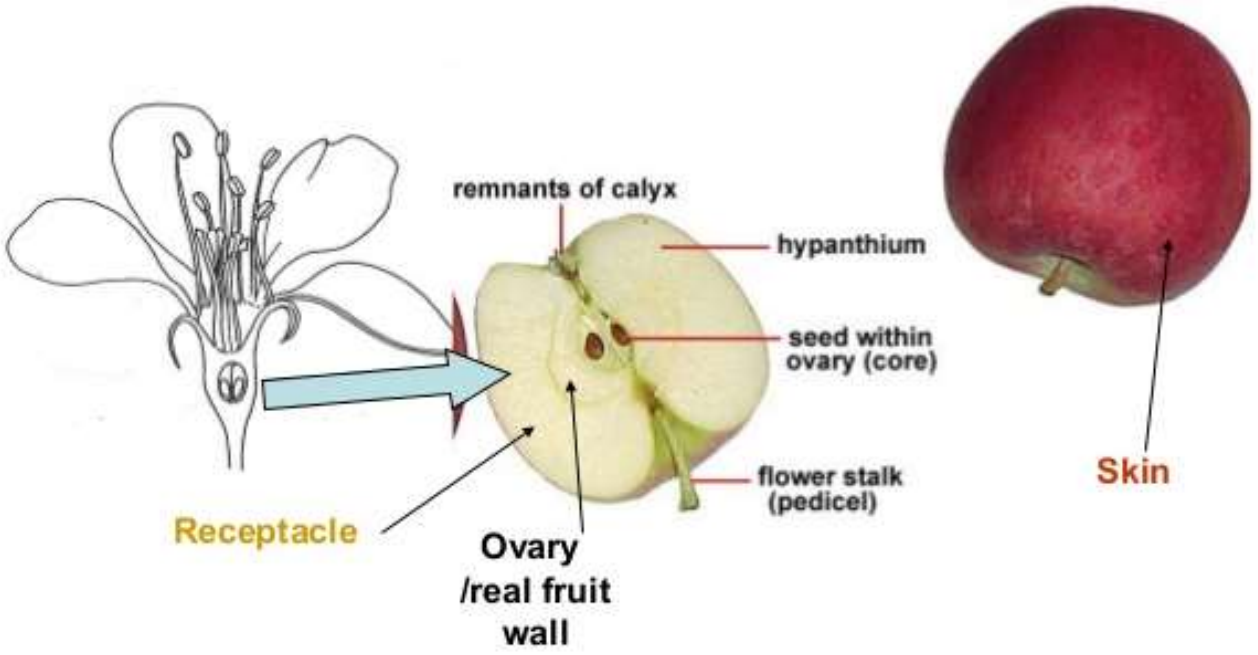
-One seed
-**Exocarp** - Woody
- **Mezocarp** – Fibrous for buoyancy
- **Endocarp** – Woody shell
- **Endosperm** – Meat of coconut



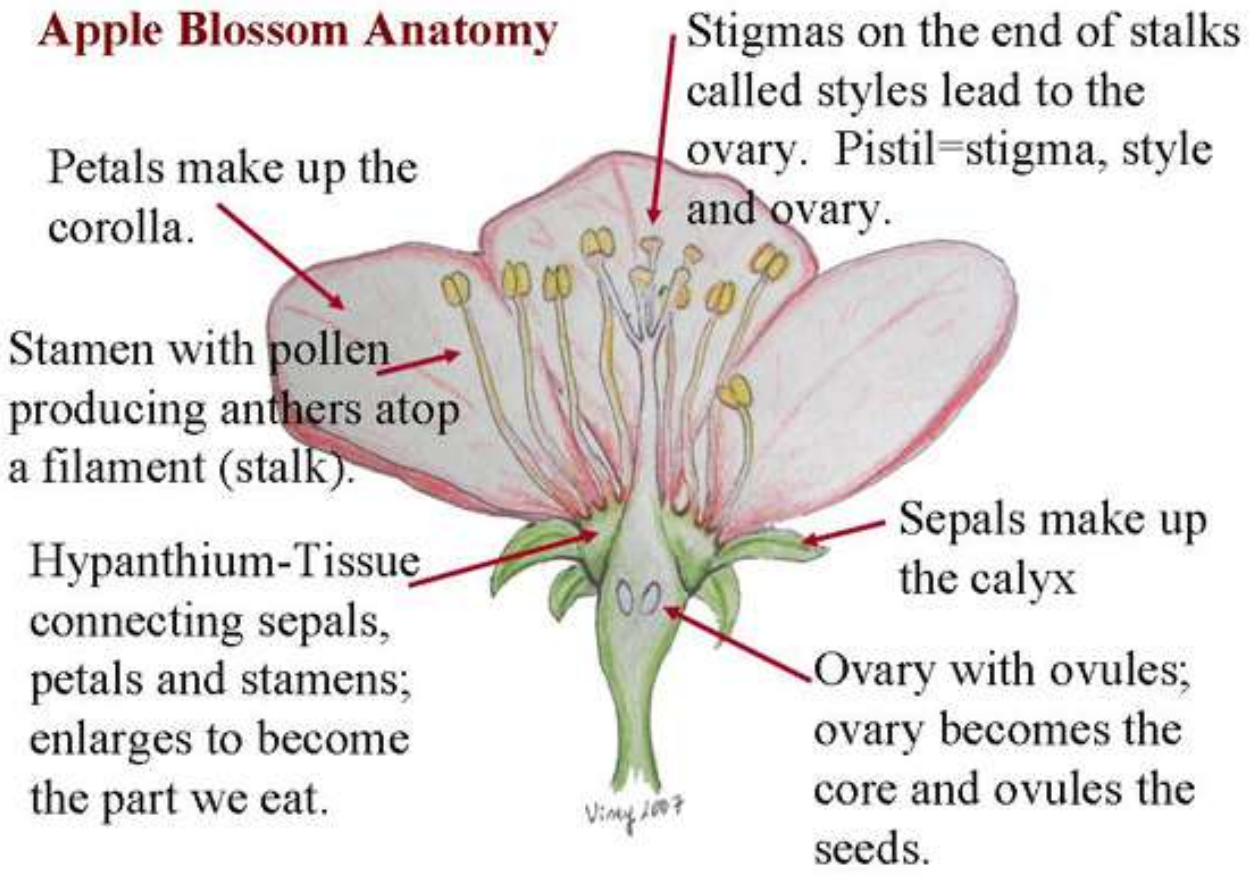
Pome

Pear

- The Core is the Ovary
- The fleshy part that we eat is the receptacle
- The receptacle is then called a hypanthium
- This is called a false or an accessory fruit



The Apple Flower



Instead of the ovary becoming the fruit, the hypanthium becomes the fruit we eat and the ovary the apple core

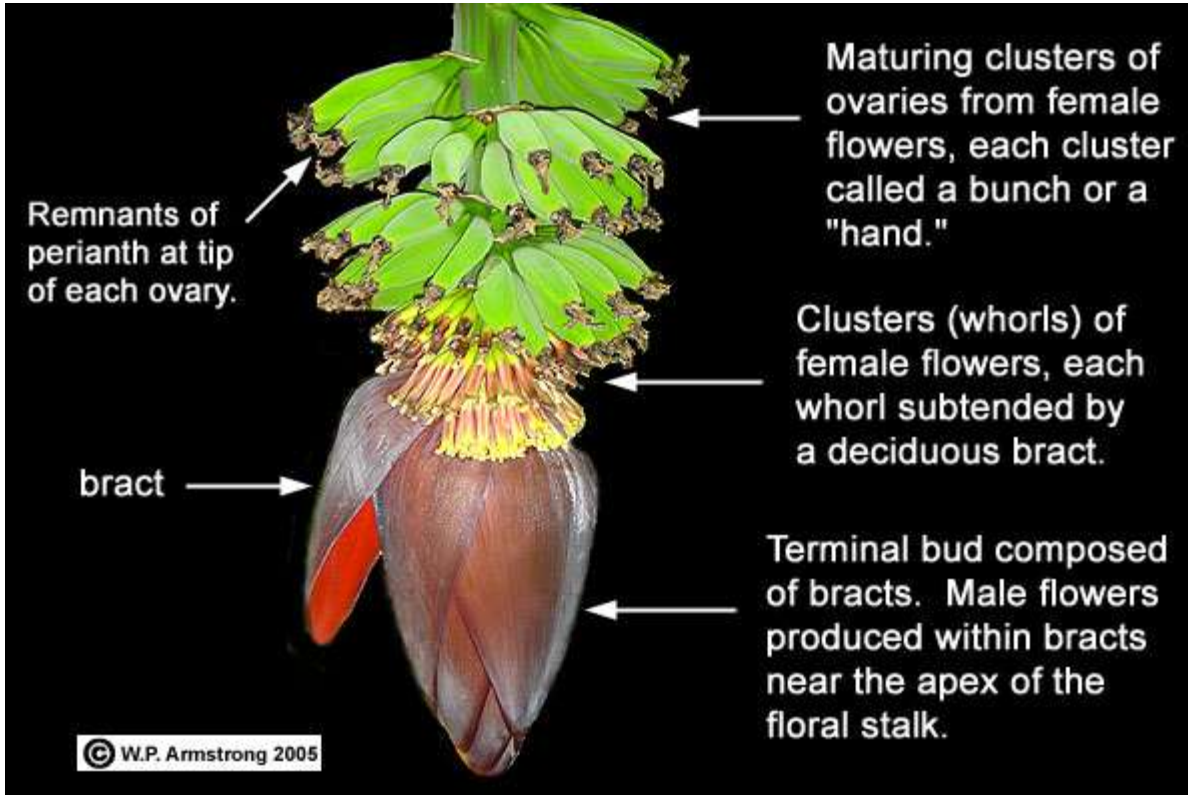
What About a Banana?

The Cavendish banana is the banana that most people consume around the world and more are eaten than all of the apples and oranges combined

Bananas

https://www.youtube.com/watch?v=27n0m6kODUQ

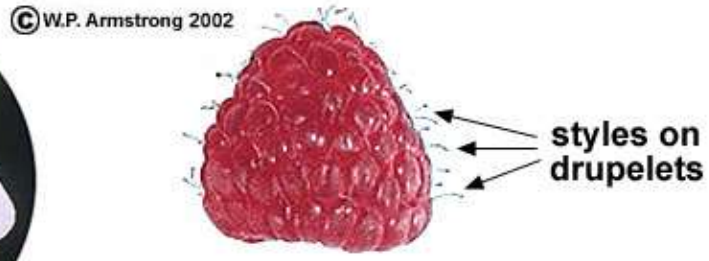
CBS Sunday Morning on the Banana



A banana is technically a berry. It is referred to a false berry because the peel we remove is the fused basses of the petals of the flowers.

Aggregate

Thimbleberry Flower



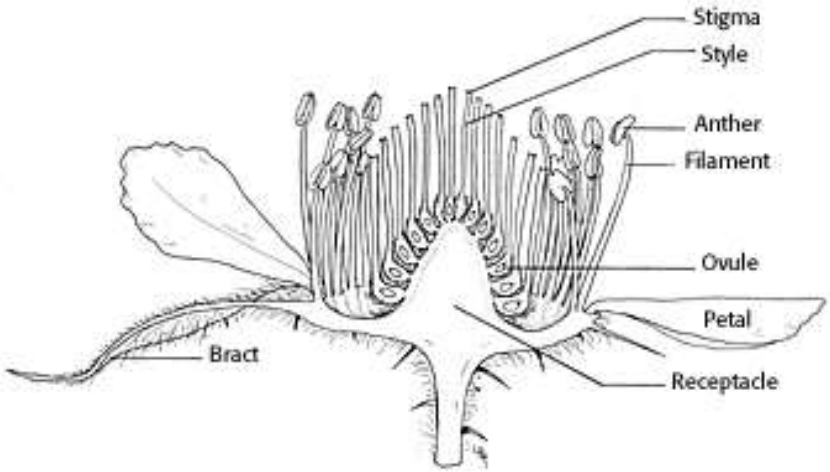
Aggregate Fruit

Many one-seeded drupelets produced by a single flower.

Thimbleberry (*Rubus parviflorus*)

An aggregate fruit is formed from a flower with many separate pistils.

The individual fruits are technically drupes and called **drupelets**



Raspberry Flower

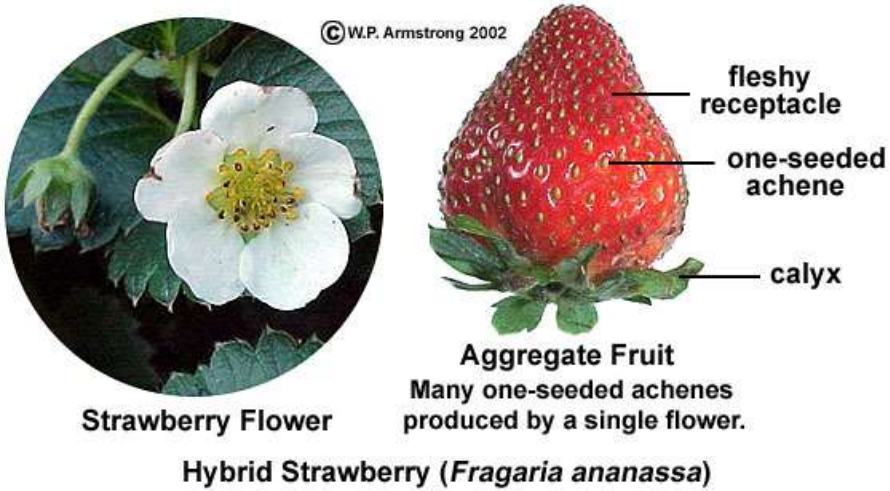
Raspberry fruits with visible **drupelets** and styles

True vs. False Aggregate

Blackberries

Raspberries

= True Aggregate Fruit



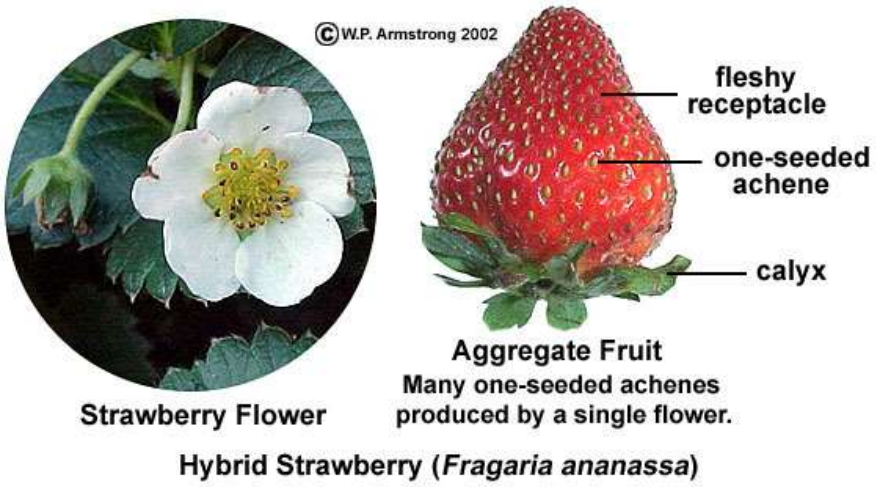
= False Aggregate Fruit

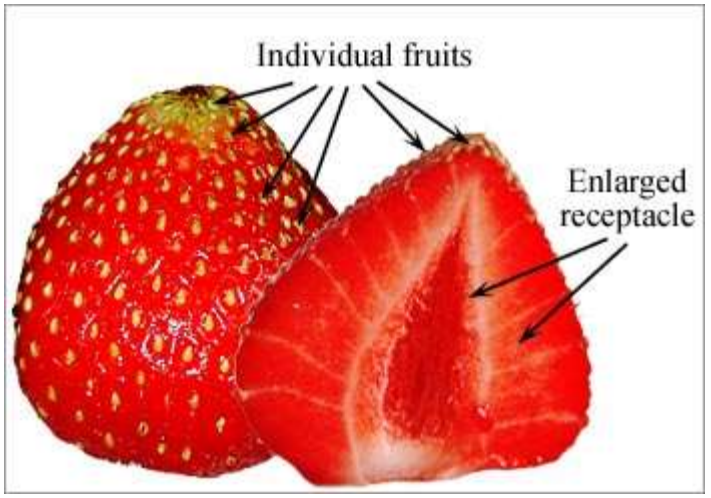
False Aggregate

Strawberries are referred to as **false aggregate** fruits since a **true fruit** is a seed in a developed ovary.

An accessory or false fruit is a fruit in which some of the flesh is derived not from the ovary but from some adjacent tissue exterior to the carpel (Flower). Examples of accessory tissue are the receptacle of the strawberry, pineapple, common fig, or mulberry.

The seeds are actually **achenes** on the outside of a swollen receptacle






ovary
stigma
style

Multiple Fruit

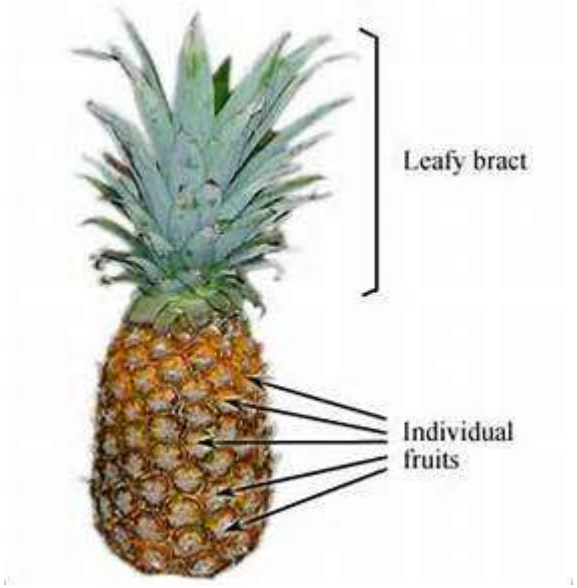
Close-up of individual flowers

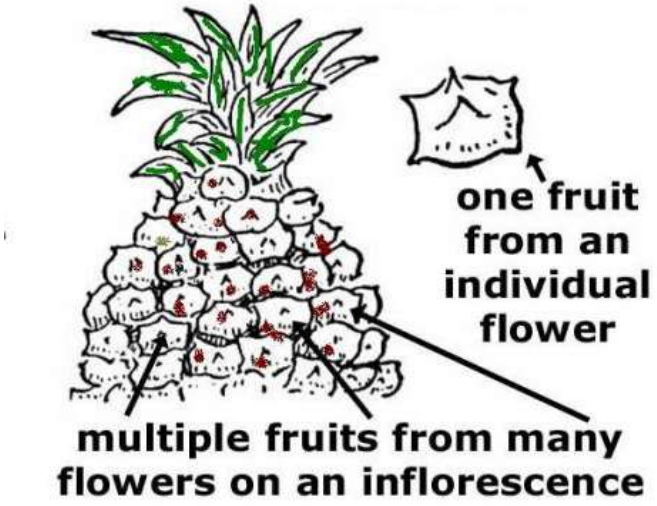
The pineapple is a bromeliad and the classic example of a **multiple fruit**

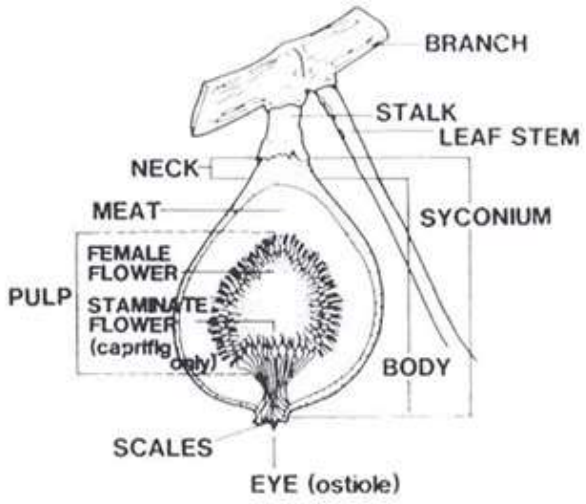
Pineapple field

The pineapple inflorescence

Pineapple

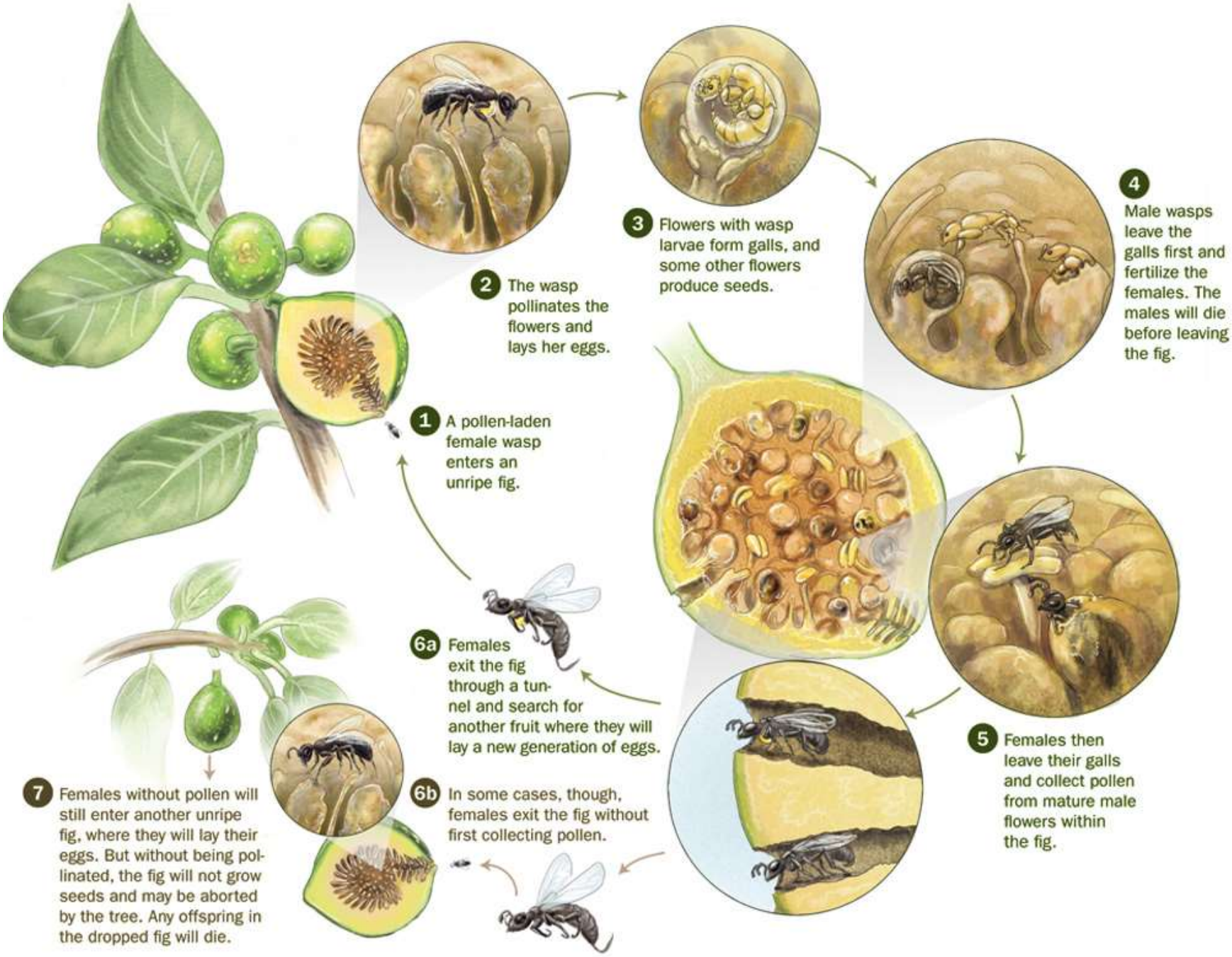

Leafy bract
Individual fruits


one fruit from an individual flower
multiple fruits from many flowers on an inflorescence



Figs are and example of an inside out flower turned fruit. Their interdependence with the wasp has been a part of their existence since the beginning.

https://www.huffingtonpost.com/entry/what-are-figs_us_57bc3dc5e4b03d51368a989a


1 A pollen-laden female wasp enters an unripe fig.
2 The wasp pollinates the flowers and lays her eggs.
3 Flowers with wasp larvae form galls, and some other flowers produce seeds.
4 Male wasps leave the galls first and fertilize the females. The males will die before leaving the fig.
5 Females then leave their galls and collect pollen from mature male flowers within the fig.
6a Females exit the fig through a tunnel and search for another fruit where they will lay a new generation of eggs.
6b In some cases, though, females exit the fig without first collecting pollen.
7 Females without pollen will still enter another unripe fig, where they will lay their eggs. But without being pollinated, the fig will not grow seeds and may be aborted by the tree. Any offspring in the dropped fig will die.

Cauliflorous Fruits

Papaya on tree trunk

Usually larger fruits more easily supported by large branches or trunks

Carob pods

Jackfruit hanging from big branches

Redbud flowers

Cacao pods on tree trunk

Breadfruit *Artocarpus altilis*

For everything you ever wanted to know about breadfruit check out the link below

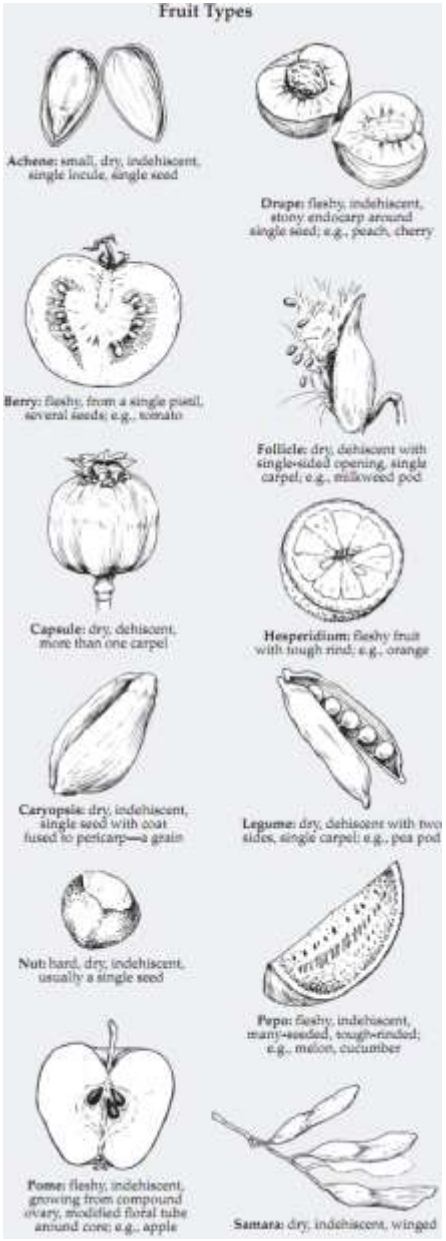
https://ntbg.org/breadfruit

Jackfruit *Artocarpus heterophyllus*

The jackfruit tree is well suited to tropical lowlands, and its fruit is the largest tree-borne fruit, reaching as much as 80 lbs. in weight, 35 inches in length, and 20 inches in diameter. A mature jackfruit tree can produce about 100 to 200 fruits in a year. The jackfruit is a **multiple fruit**, composed of hundreds to thousands of individual flowers, and it is the fleshy petals that are eaten.

The jackfruit tree is a widely cultivated and popular food item throughout the tropical regions of the world. Jackfruit is the national fruit of Bangladesh.

Could you give an example of all of these fruits types without the pictures?

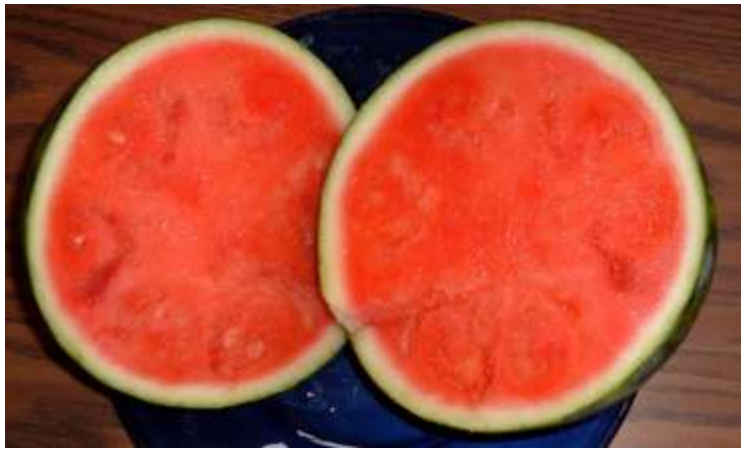


Achene
Berry
Capsule
Caryopsis
Nut
Pome
Drupe
Follicle
Hesperidium
Pepo
Samara

Table of Fruits

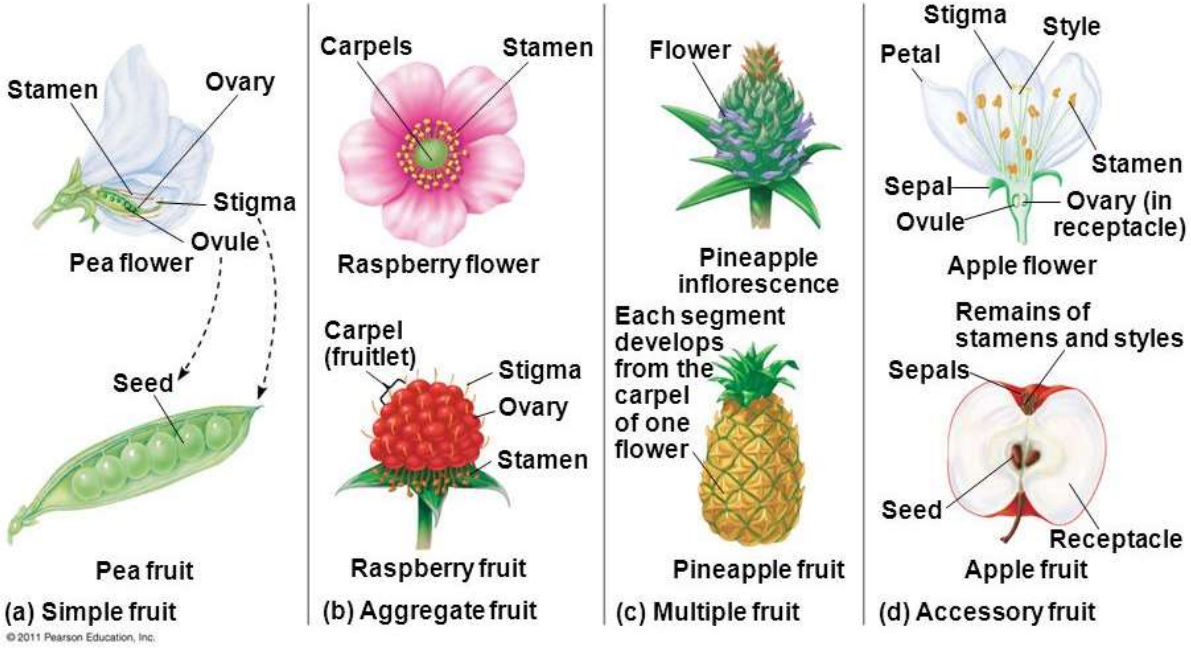
Type	Compartments	# Seeds	Splits	Dehiscent	Indehiscent	Dry	Fleshy	Pericarp	Simple
Pod	1	many	2	yes	no	yes	no		yes
Follicle	1	many	1	yes	no	yes	no		yes
Capsule	more than 1	many	each compt	yes	no	yes	no		yes
Achene	Papery pericarp	1		no	yes	yes	no		yes
Caryopsis	Pericarp fused to testa	1		no	yes	yes	no		yes
Nut	Woody pericarp	1		no	yes	yes	no		yes
Samara	Ovary to wings	1 or 2		no	yes	yes	no		yes
Berries	1 or more	many		no	no	no	yes	Thin exocarp, fleshy mesocarp & endocarp	yes
Hesperidium	Segments - ovary compt	many		no	no	no	yes	Exocarp & mesocarp = rind, endocarp segments	yes
Drupes	1	1		no	no	no	yes	Exocarp= skin, mesocarp= fleshy, Endocarp= woody	yes
Pomes	core = ovary	many		no	no	no	yes	Fleshy part = receptacle	yes
Aggregate		many		no	no	no	yes	From flower with many separate pistils	no
Multiple								Formed from inflorescence of closely placed flowers	no
Cauliflory								Heavy, large fruits	
Parthenocarpic								No seeds	

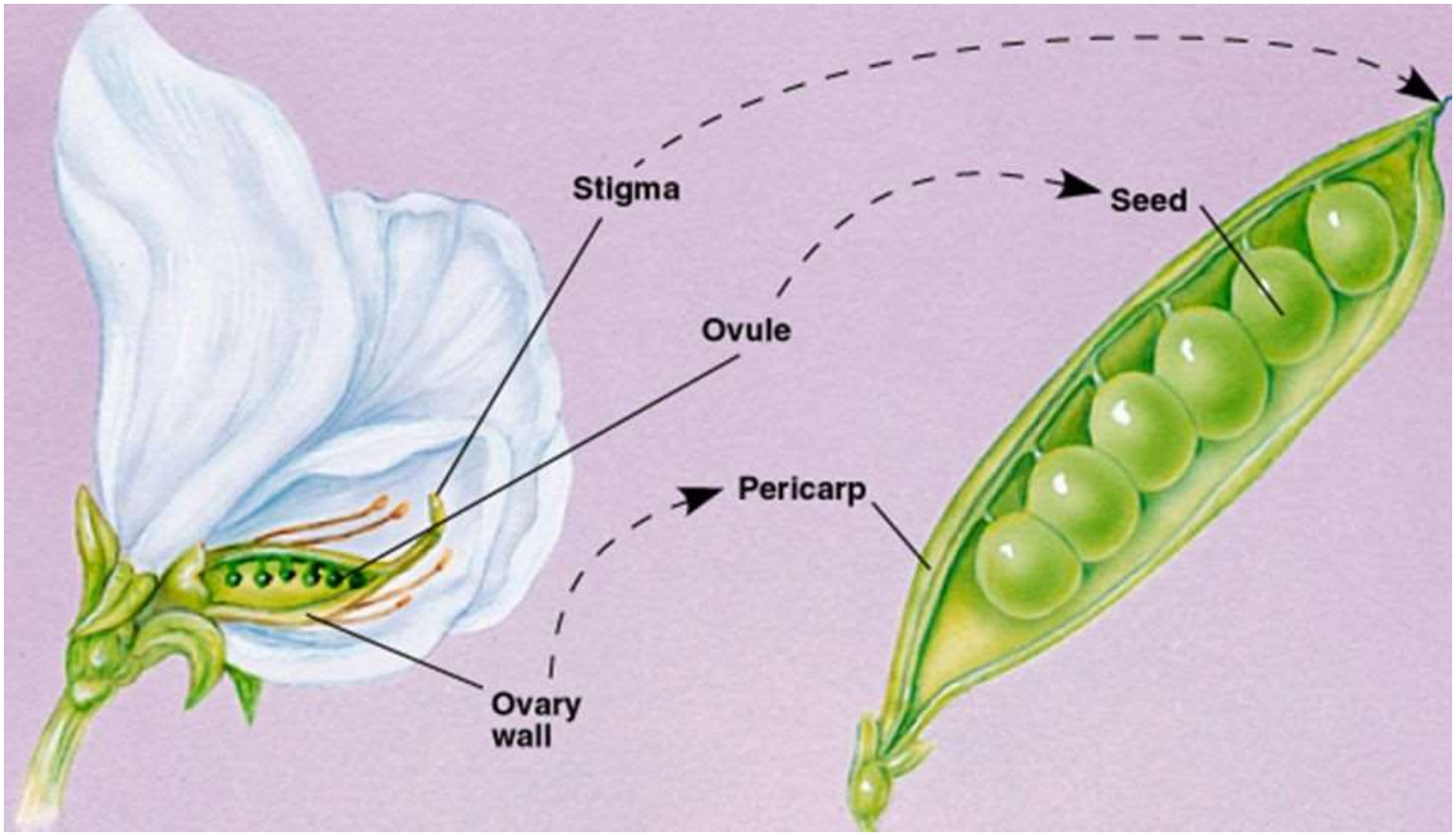
Parthenocarpic Fruits



In botany and horticulture, **parthenocarpy** (literally meaning virgin fruit) is the natural or artificially induced production of fruit without fertilization of ovuoles. The fruit is therefore seedless. Stenospermocarpy may also produce apparently seedless fruit, but the seeds are actually aborted while still small.

Seeds




Stigma
Seed
Ovule
Pericarp
Ovary wall