

FRUIT



- Fertilised & ripened ovary
- fruits developed from ovary – true fruits (Mango)
- Fruits from parts other than ovary – False fruits (Pseudocarps) – Apple {pulp developed from thalamus}

Fruit development:

- Pollination in flower stimulates growth & development of ovary
- prevents abscission
- auxins from pollen & carpels initiate ovary growth
- again, seeds secrete auxin, gibberellin, cytokinin- help in fruit development
- within ovary – enlargement, succulent parenchyma cells develop with starch, and vegetable acids
- false septa formation & dissolution of septa in ovary
- ovary wall changed to fruit wall (Pericarp)

Ripening process:

* Conversion of starch to sugar, decrease in acid conc., ester production, chlorophyll breakdown, transformation of chloroplast to chromoplast.

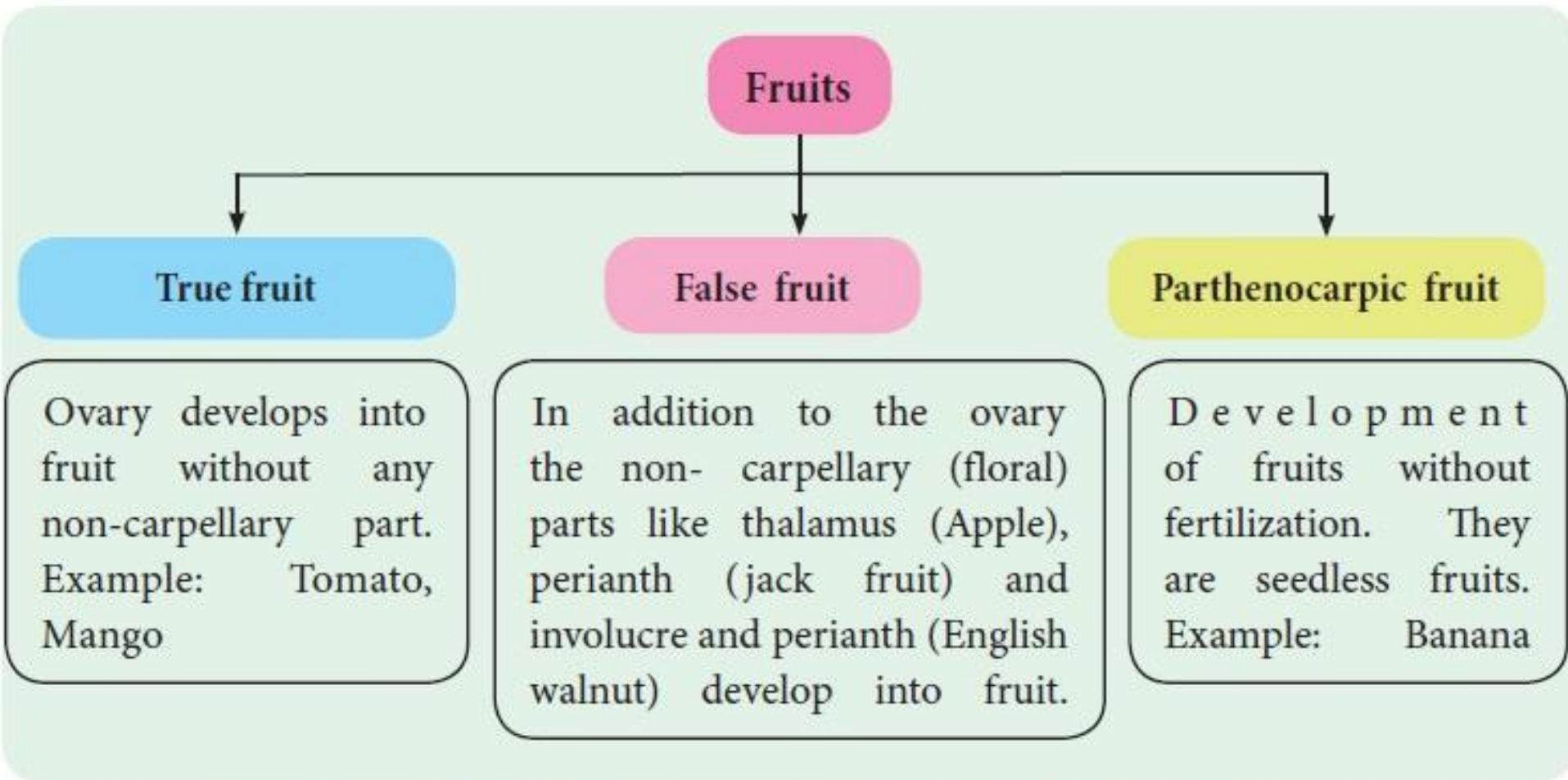
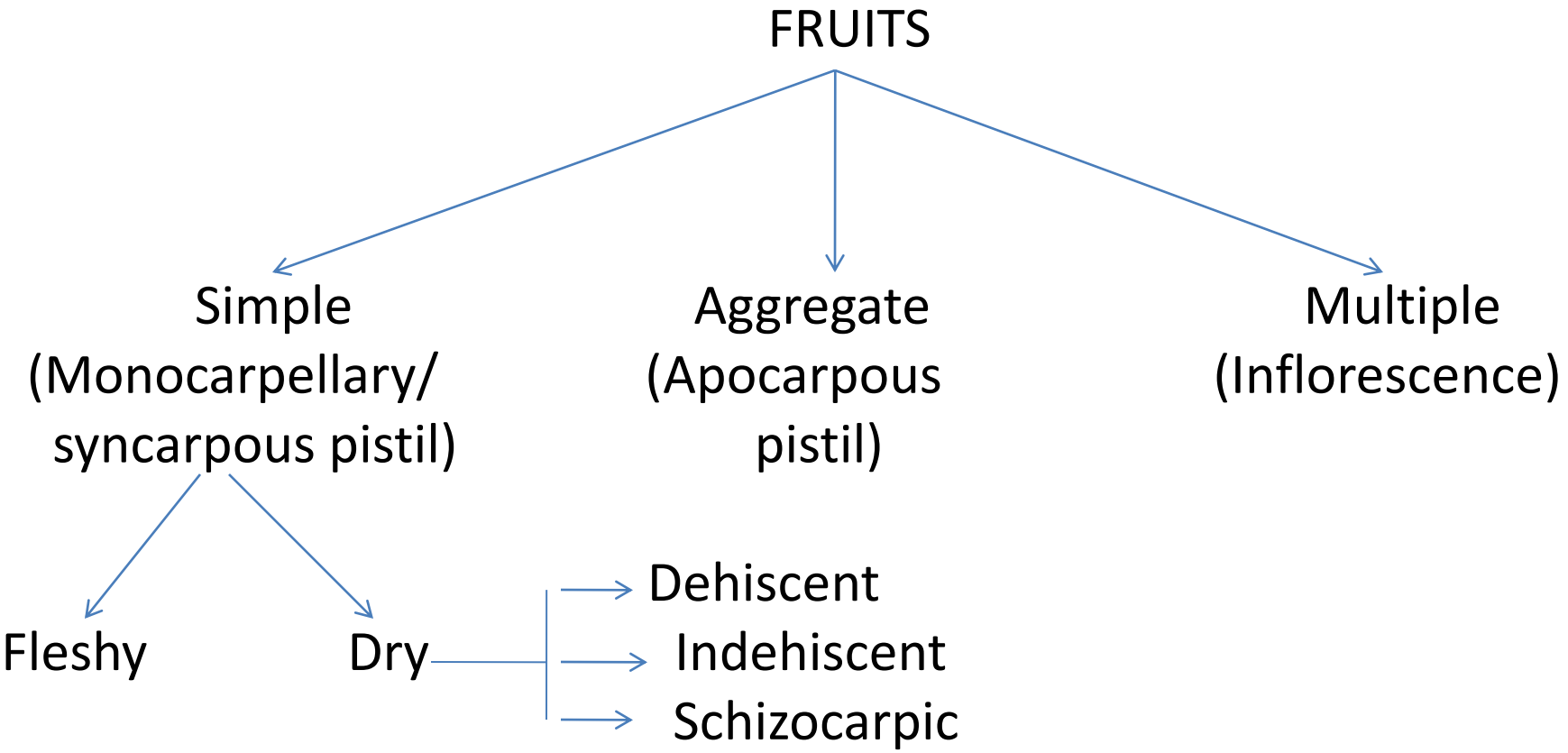


Figure 4.39: Classification of fruits based on formation

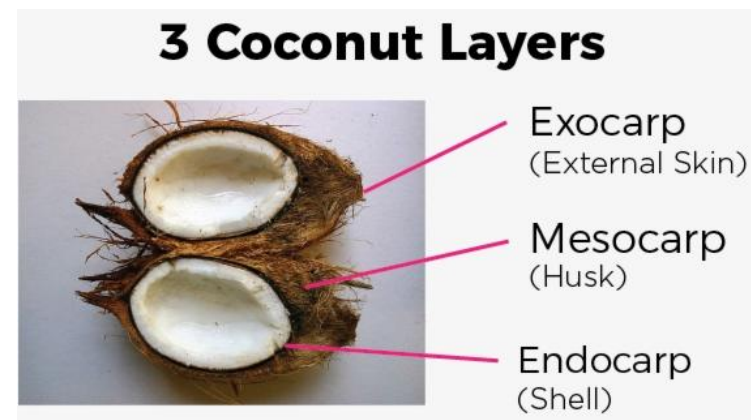
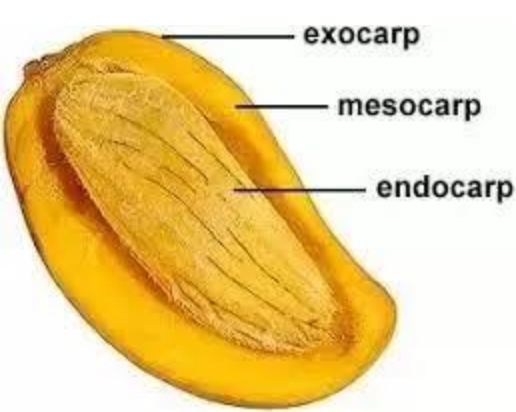
Why fruit is formed?

- Seed protection
- Seed dispersal
- Chemical defence against animals preventing eating up when unripe.



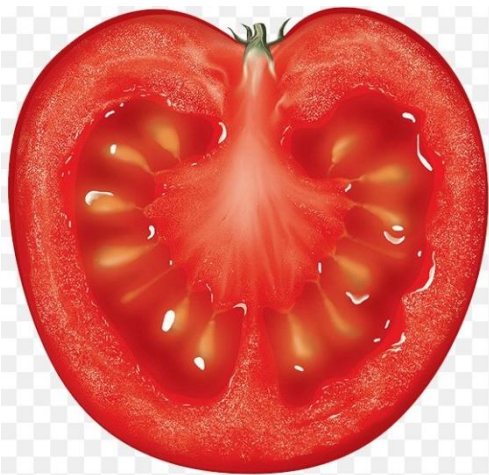
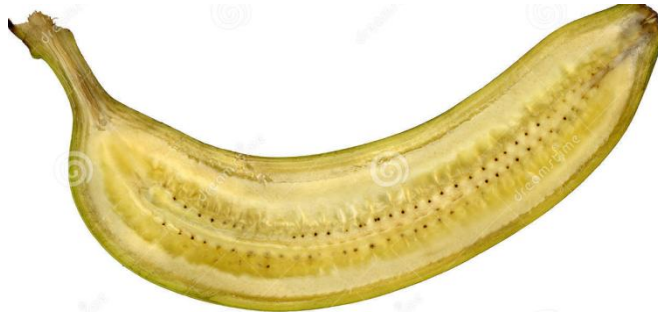
SIMPLE FRUITS

- Develop from single flowers with monocarpellary/ syncarpous pistil
- 2 types – fleshy & dry
- Fleshy fruits – pericarp fleshy, juicy
- 5 types – Drupe, Berry, Pome, Pepo, Hesperidium
- **DRUPE** – from mono/ polycarpellary syncarpous superior ovary.
- multi/ monolocular single seeded indehiscent fruit
- pericarp – thin epicarp, fibrous/ fleshy mesocarp, hard endocarp
- Mango, plum, coconut



BERRY – Mono/ polycarpellary superior/ inferior ovary with axile/ parietal placentation

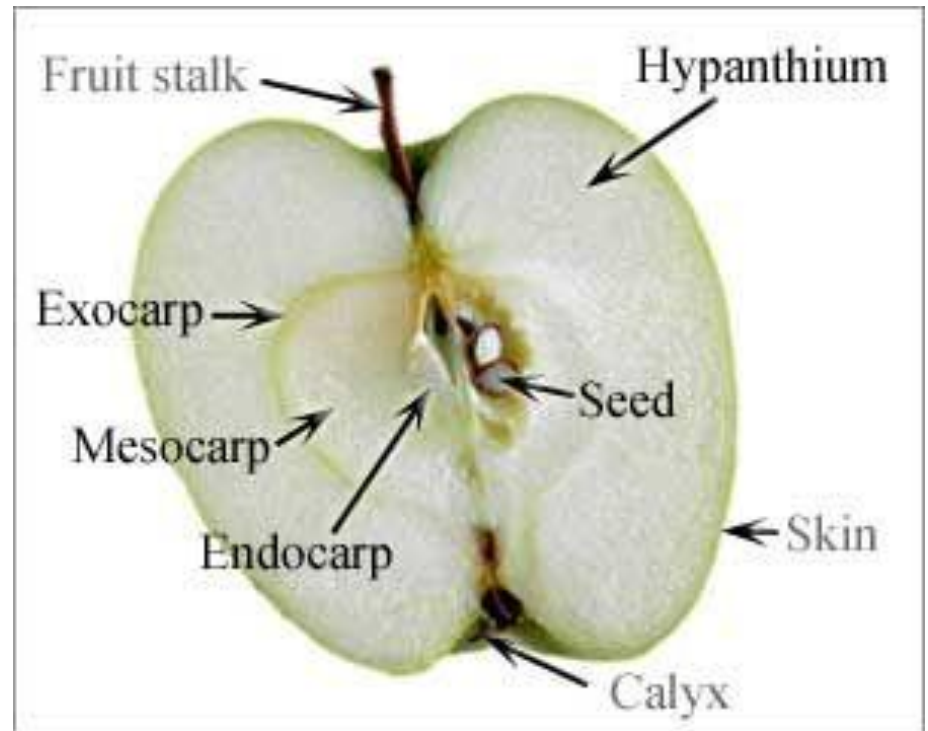
- Pericarp – very thin epicarp forming skin, pulpy succulent mesocarp with embedded seeds, endocarp thin/ absent
- Many seeded indehiscent pulpy fruit
- tomato, banana, grape, sapota, brinjal



POME - false fruit from fleshy receptacle

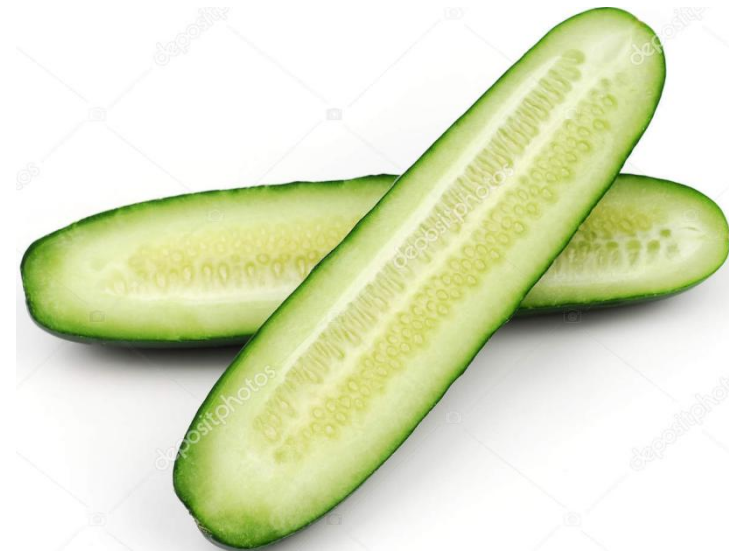
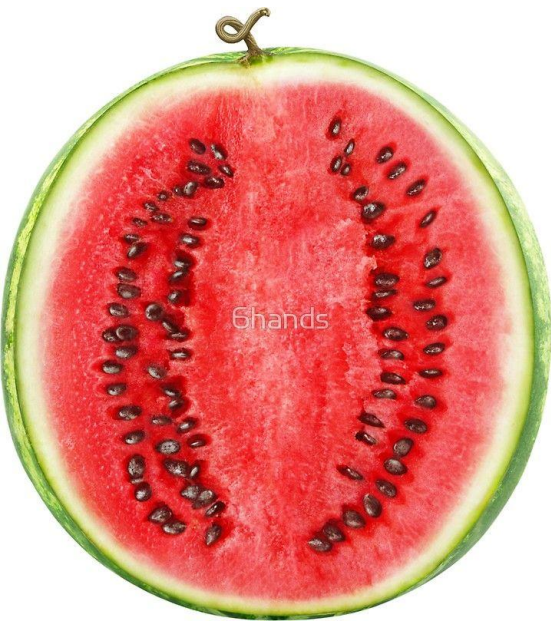
* from syncarpous inferior ovary

- Fruit skin is not epicarp
- fleshy edible part is not mesocarp.
- typical of family Rosaceae
- Specialised edible fruit
- Apple, Pear



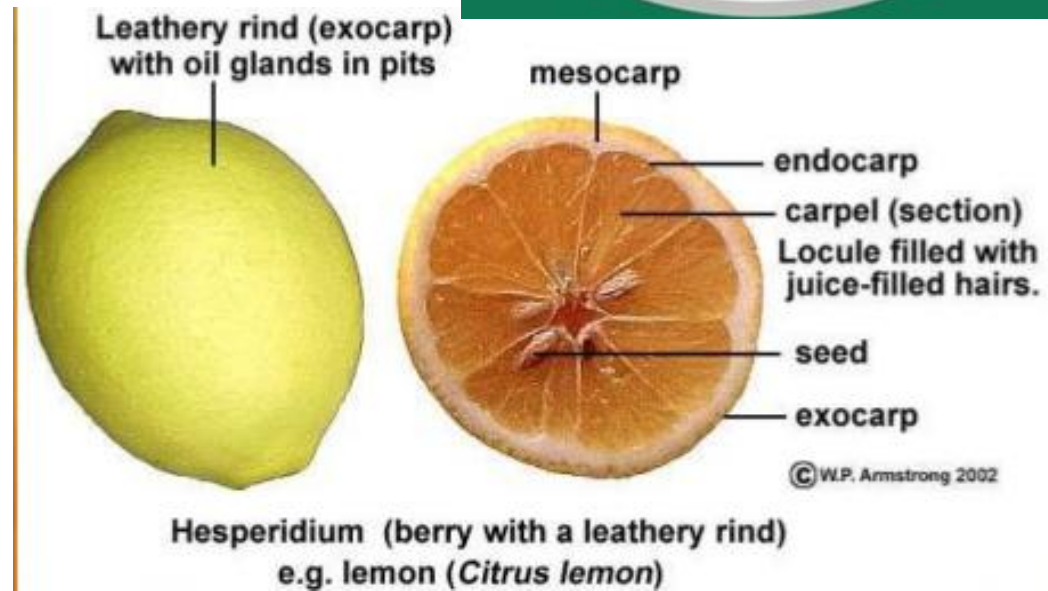
PEPO –specialized berry

- * from inferior syncarpous ovary
- * many seeded fleshy large fruit
- Epicarp leathery covering
- mesocarp juicy
- endocarp transparent surrounding seeds, slimy
- typical of Cucurbitaceae
- Cucumis, Ashgourd, Watermelon, pumpkin



HESPERIDIUM – from multicarpellary syncarpous superior ovary with axile placentation

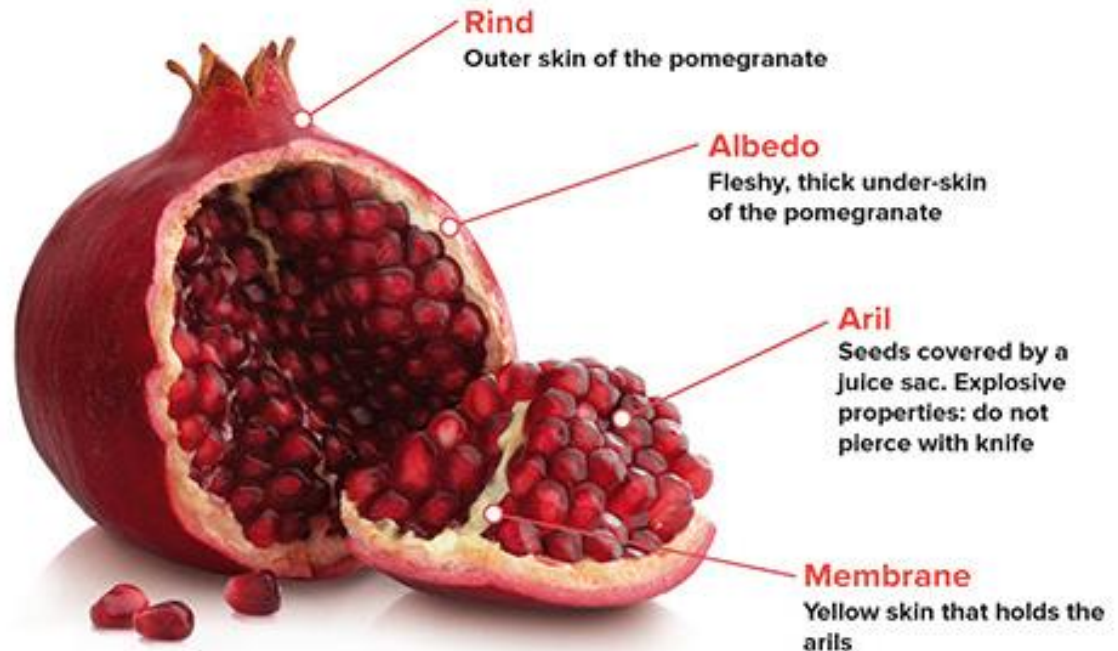
- Multiseeded fleshy fruit
- pericarp to epicarp, mesocarp & endocarp
- Epicarp leathery with oil glands
- mesocarp fibrous
- endocarp with unicellular fluid filled trichomes projecting to locules
- endocarp edible
- Lemon, Orange, Grapefruit, Pomelo



BALAUSTA: from multicarpellary, multilocular syncarpous inferior ovary

- * fleshy indehiscent fruit
- * pericarp tough, leathery
- Many celled & large no. of Seeds attached irregularly
- partition by thin wall of carpels
- * Succulent Testa is the edible portion.
- * Persistent calyx
- * Pomegranate.

Inside the pomegranate



DRY FRUITS – hard & dry pericarp

- 3 types – Dehiscent, Indehiscent & Schizocarpic

- ❖ **DRY DEHISCENT** - dry pericarp splits open to liberate seeds.

- Develop from monocarpellary pistil

- 4 types – Legume/ Pod, Follicle, Siliqua, capsule

- **LEGUME/POD** – monocarpellary unilocular pistil with marginal placentation

- Seeds arranged on the ventral suture

- dehisce by dorsal & ventral suture to 2 valves

- dehiscence by drying of carpel wall

- release either by explosion/ twisting of valves

- typical of leguminosae

- Pea, adenanthera.



Legume - Acacia (*Acacia*), Alfalfa (*Medicago sativa*), Flamboyant (*Delonix regia*), Peanut (*Arachis hypogaea*), Runner Bean (*Phaseolus coccineus*), Wisteria (*Wisteria*).





Acacia nilotica – lomentum



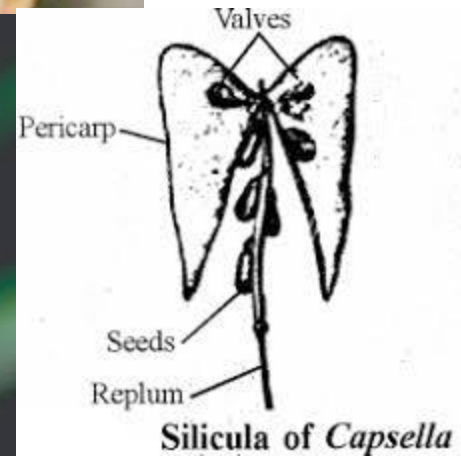
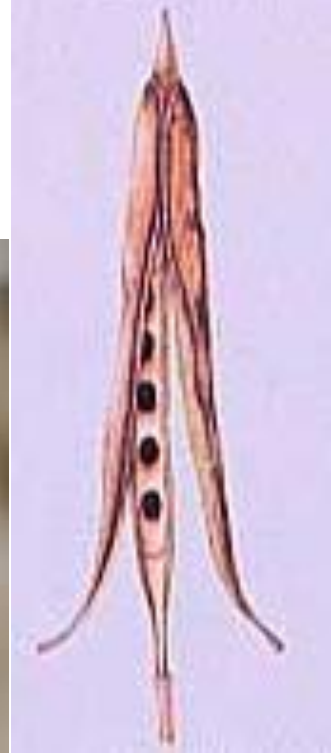


Follicle - dry dehiscent **fruit** from monocarpellary superior unilocular ovary with marginal placentation which splits on one side only (ventral suture). It may contain one or many seeds. Larkspur (*Consolida*), *Nigella damascena*, Milkweed (*Asclepias*), Peony (*Paeonia*).



• SILIQUA

- Dry dehiscent
- from bicarpellary syncarpous superior ovary with parietal placentation
- pericarp splits to two valves.
- in cruciferae (Raphanus, Mustard)
- Small siliqua – Silicule (capsella – shepherd's purse)
- Cental axis – Replum
- seeds embedded in the replum
- dehisce from down to up



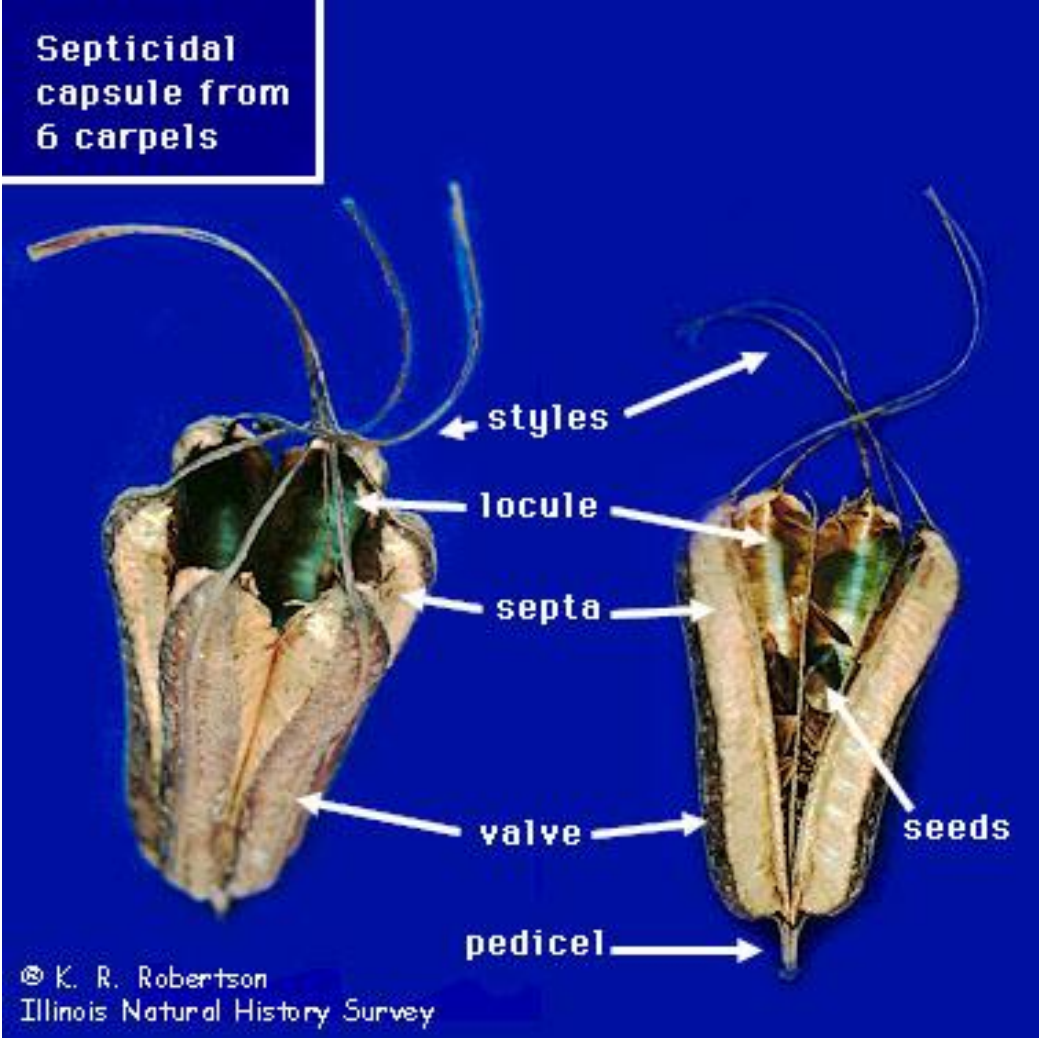
CAPSULE

- Dry dehiscent developing from syncarpous pistils
- named on the basis of modes of dehiscence
- a) **loculicidal capsule**
- fruit valve burst in middle of each locule
- no. of valves = no. of carpels
- Eg: *Gossypium* (Cotton)
- *Abelmoschus esculentus* (Lady's finger)
- pericarp not falling from middle septa



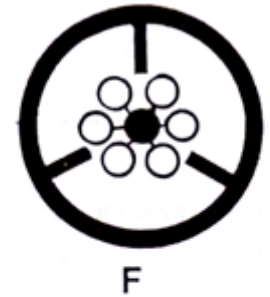
Septicidal Capsule

- longitudinal splitting through middle septum
- not exposed during dehiscence
- released as loculicidal capsule
- Eg: Aristolochia (flower basket)
- pericarp not falling from middle septa



•Septifragal capsule

- outer walls break away from valves of loculi.
- Pericarp completely breaks from septa
- first dehiscence loculicidal-loculididally septifragal (Lagerstroemia)
- first dehiscence septicidal – Septicidally septifragal (Datura)



•Porous Capsule

- capsule with numerous small holes at top
- by vigorous shaking , seeds released out
- eg: Poppy



❖ DRY INDEHISCENT FRUITS:

Single seeded fruits

Do not burst / dehisce to release seeds

Pericarp ruptures during seed germination

Common types - [Achene](#), [Utricle](#), [Caryopsis](#), [Cypsela](#), [Samara](#), [Nut](#)

a) [Achene](#) –

*Small, single seeded unilocular, from monocarpellary superior ovary

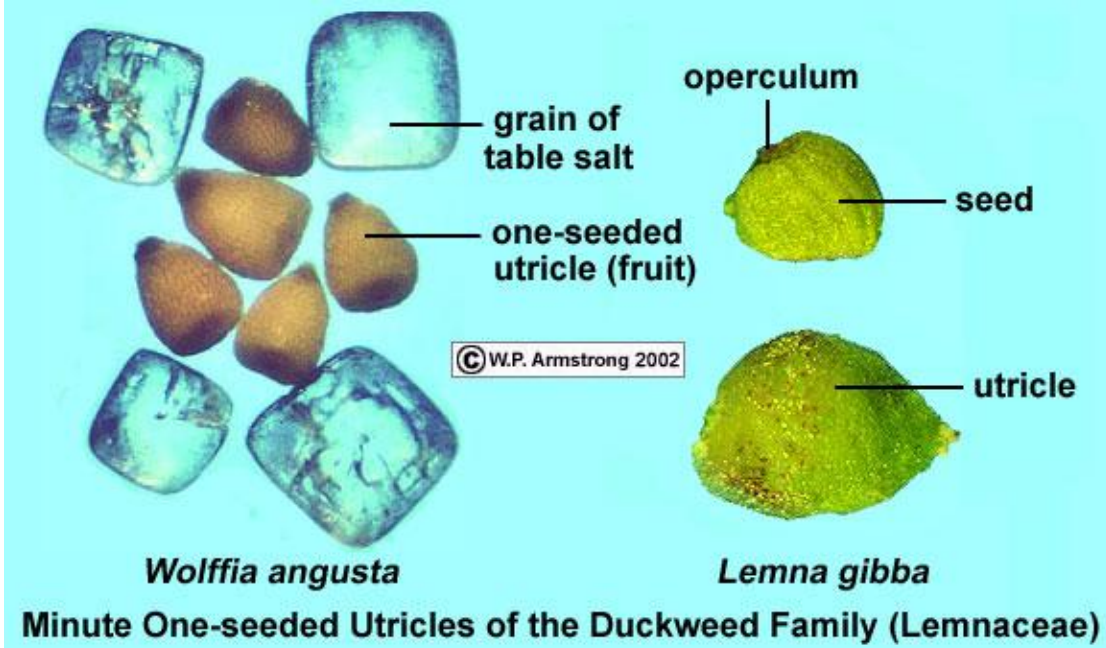
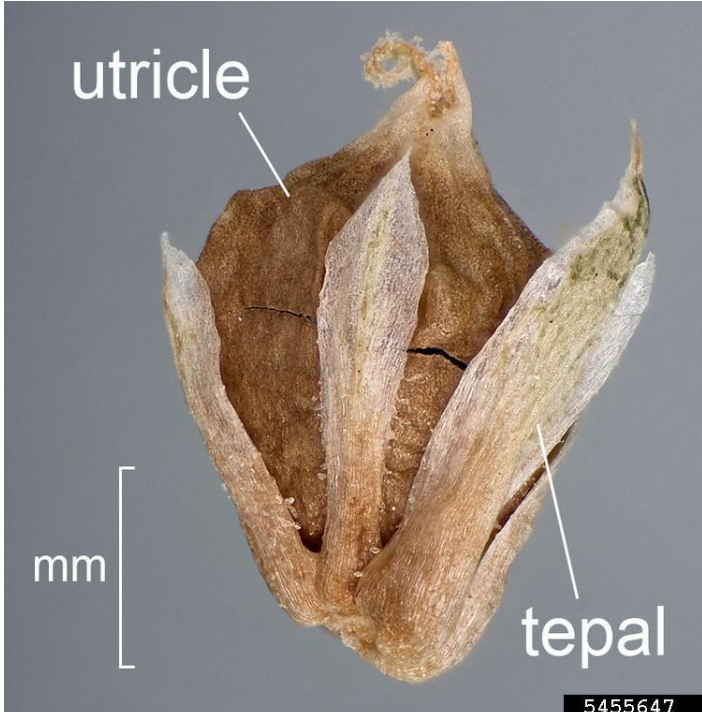
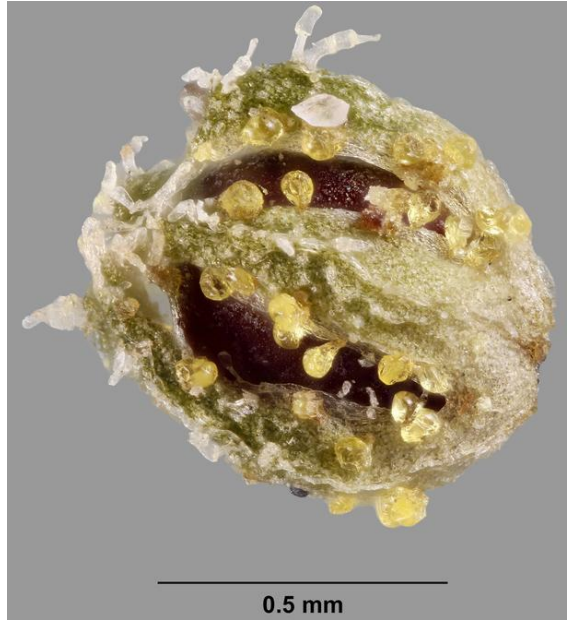
- Pericarp dry, membranous
- pericarp free from seed coat
- *Mirabilis*



b) Utricle

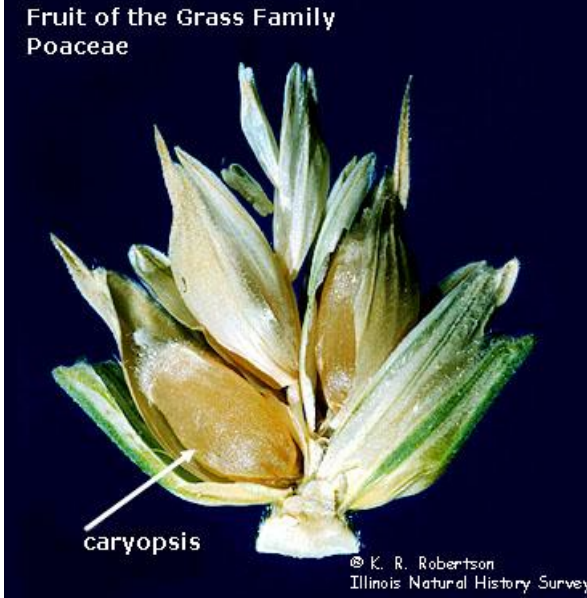
* modified form of achene

- Bladder like
- seed small
- occupy small part of the fruit
- Amaranthus
- Family Amaranthaceae & Chenopodiaceae

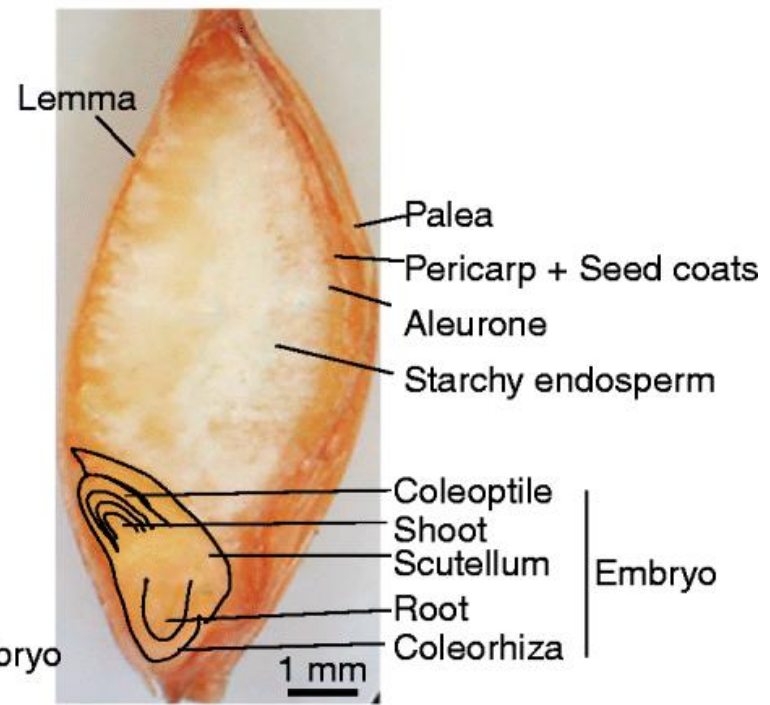
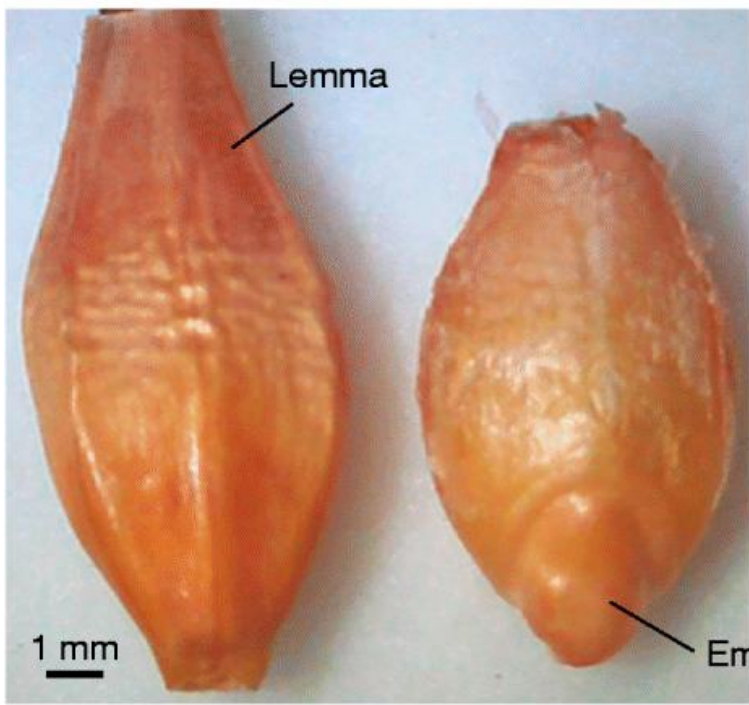


c) Caryopsis

- single seeded form monocarpellary superior unilocular ovary
- pericarp fused with seed coat
- grain covered by persistent bracts & bracteoles
- seen in family Gramineae
- Wheat, Maize

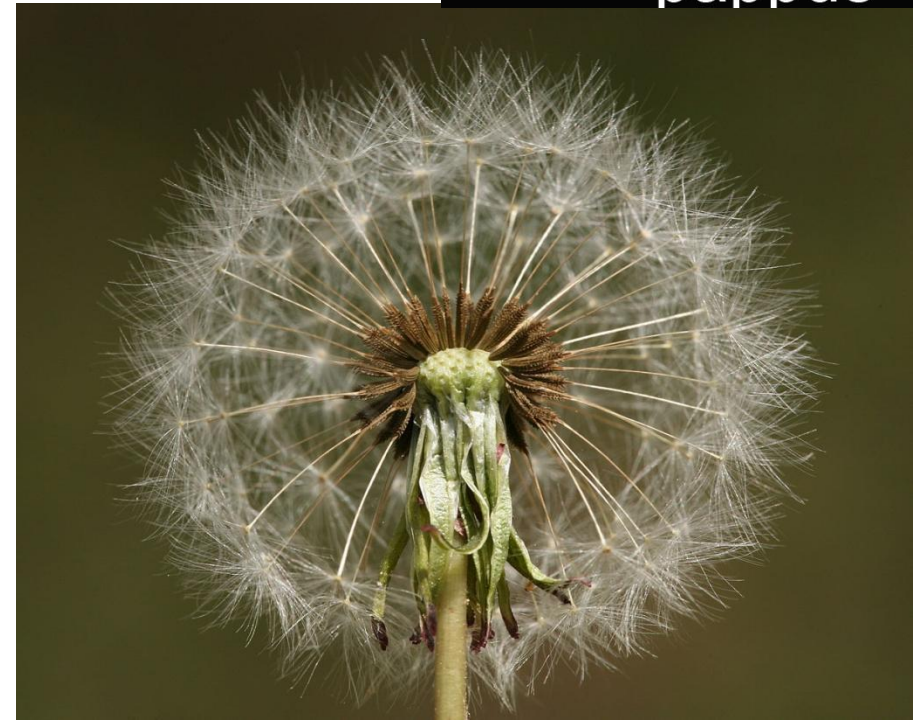
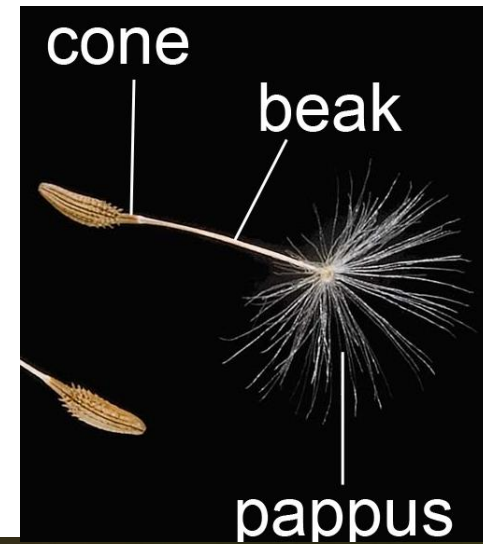


(A) Barley caryopsis
With glumellae Without glumellae



d) Cypsela

- single seeded unilocular from bicarpellary syncarpous inferior ovary
- pericarp separate from seed coat
- fruits surrounded by pappus hairs
- characteristic of Compositae



e) Samara

- * winged achene, Single seeded
- membranous wing like pericarp
- helps in wind dispersal of seeds
- Pterocarpus, Holoptelia, Dodonaea



f) Samaroid

- * winged achene, Single seeded
- membranous wing developed from parts other than ovary (Sepals, petals, Bracts etc.)
- helps in wind dispersal of seeds
- Shorea ,Acer (sepals),



f) Nut

- Hard & single seeded
- from syncarpous ovary
- all seeds, except one get aborted
- pericarp lignified
- partially / completely surrounded by cupule
- Cashewnut



❖ SCHIZOCARPIC FRUITS

Intermediate between dehiscent & indehiscent fruits

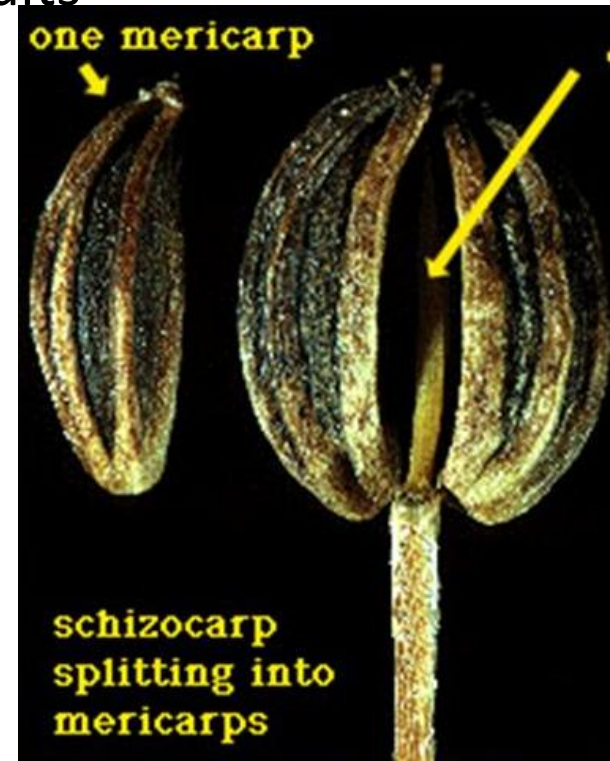
Formed from two/ more one seeded carpels

These divide to single seeded units at maturity

Common - **Mericaarp**, **Cremocarp**,
Lomentum, **Carcerulus**

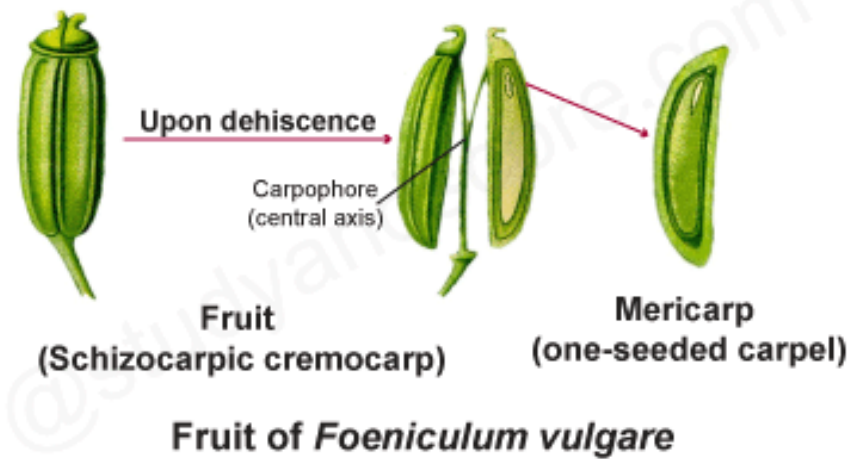
a) Mericaarp

- Single seeded portions of fruit
- Splitting at maturity
- dehiscent/ indehiscent
- Also known as coccus



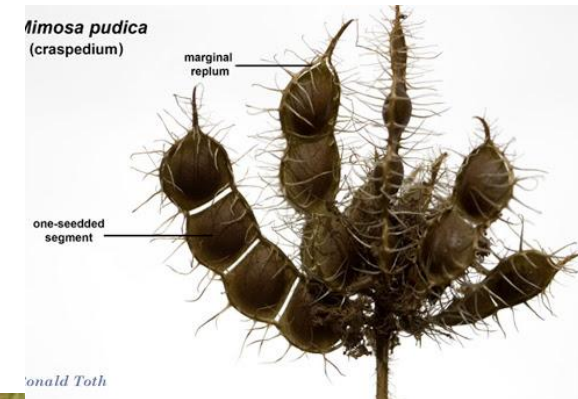
b) Cremocarp

- * bilocular two seeded schizocarp
- From bicarpellary syncarpous inferior ovary
- mature, two single seeded unilocular units
- mericarp hang down from carpophore
- members of Umbelliferae



c) Lomentum

- * elongated dry schizocarp
- From monocarpellary superior ovary
- with one/ more seeds
- At maturity, transverse constrictions developed
- portions broken to form one seeded bits (mericarps)



d) Carcerulus

* dry from multicarpellary syncarpous superior ovary

- At maturity, splits
- several single seeded segments
- seen in Lamiaceae



Carcerulus (*Abutilon*)

AGGREGATE FRUITS

- “CLUSTER FRUIT”
- from apocarpous pistil of single flower
- collection of individual fruits
- ‘etaerio’ – designate aggregate fruit
- types – aggregate of achenes, berries, follicles, samara
- each carpel develops to fruitlet
- flower has cluster of fruitlets
- free fruitlets (*Polyalthia*)
- fused fruitlets (*Annona*)
- dehiscent/ indehiscent



- Aggregate of achenes – Naravelia, strawberry
- Aggregate of follicle – Michelia
- Aggregate of berries – Artabortys
- Aggregate of samara – Dodonaea



MULTIPLE FRUITS

developing from inflorescence

massive fleshy compound fruit

Fusion of ovaries & floral parts of entire inflorescence

Types - [Sorosis](#), [Syconus](#), [coenocarpium](#)

a) [Sorosis](#)

- From spike, spadix/ catkin
- Jack fruit (Artocarpus, Morus)
- here inflorescence unisexual
- female spike develops to fruit
- peduncle form central axis
- perianth of flower –edible, fleshy, succulent
- pericarp – white membranous bag with seed inside
- whitish nonedible parts – sterile/ unfertilized flowers
- hexagonal areas single flowers
- pointed part – stigma points



b) Syconus

- Developing from hypanthodium inflorescence
- Ficus
- receptacle form fleshy pericarp
- achenes embedded in the fleshy mass



c) Coenocarpium

- * formed by fusion
- ovaries, floral parts & receptacle fuse
- Axis fleshy
- Ananas
- inflorescence axis from fruit axis
- grows beyond with bracts sterile above.
- poygonal area – flower + bract



SEED

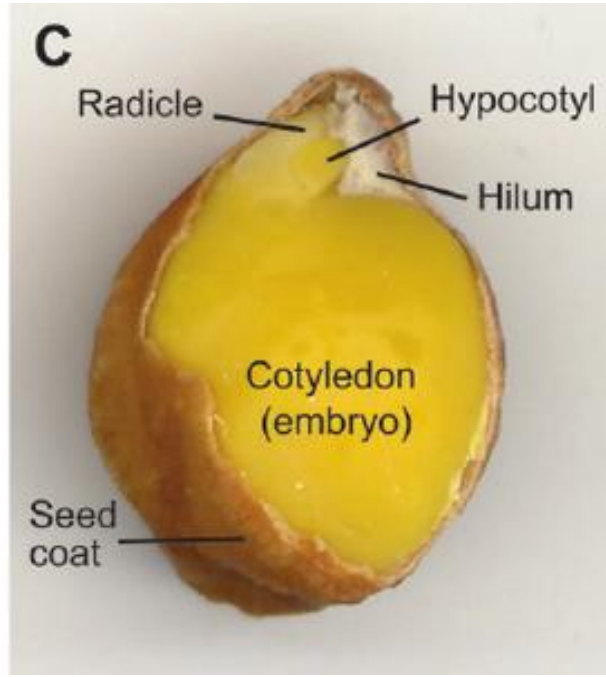
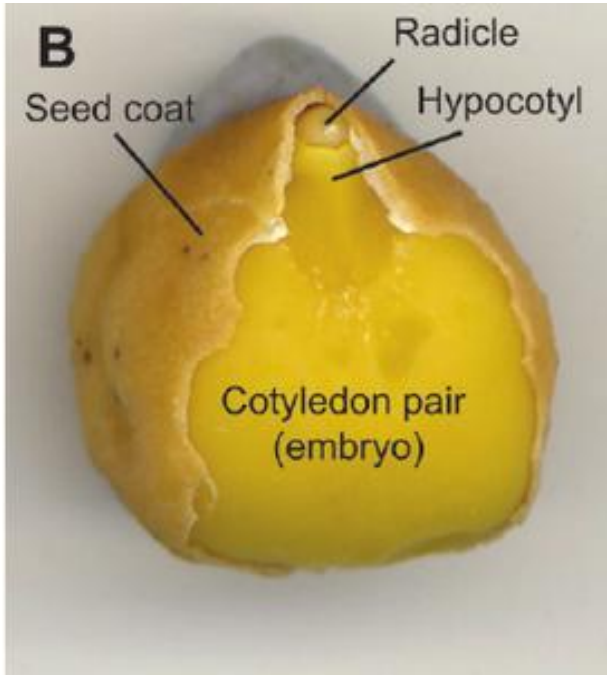
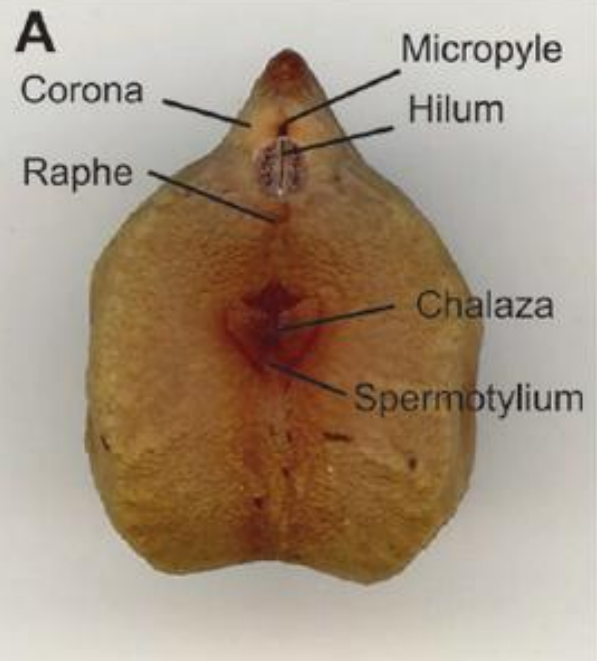
Seed formation:-

- Ovule integuments form seed coat
- outer integument – testa
- inner integument – tegmen
- fertilised egg – embryo
- embryo with a) radicle , b) plumule & c) 1/2 cotyledons
- cotyledons leaf like
- plants with 2 cotyledons – dicotyledons (bean, pea, tamarind)
- plants with one cotyledon – Monocotyledons (Paddy, maize, wheat, coconut)
- normally food for embryo in endosperm
- sometimes, stored in cotyledons (starch, protein, oil)
- in such seeds, no endosperm (nonendospermous/ exalbuminous) – bean, pea
- seeds with endosperm – endospermous/ albuminous seeds (Castor, wheat, Date)

- Types of seeds based on endosperm:
 - a) endospermous/ Albuminous – Castor, tamarind
 - b) nonendospermous/ Exalbuminous – Peas, beans, gram
 - c) perispermic – black pepper, water-lily
- Perispermic seeds – parts of nucellus remaining in seed

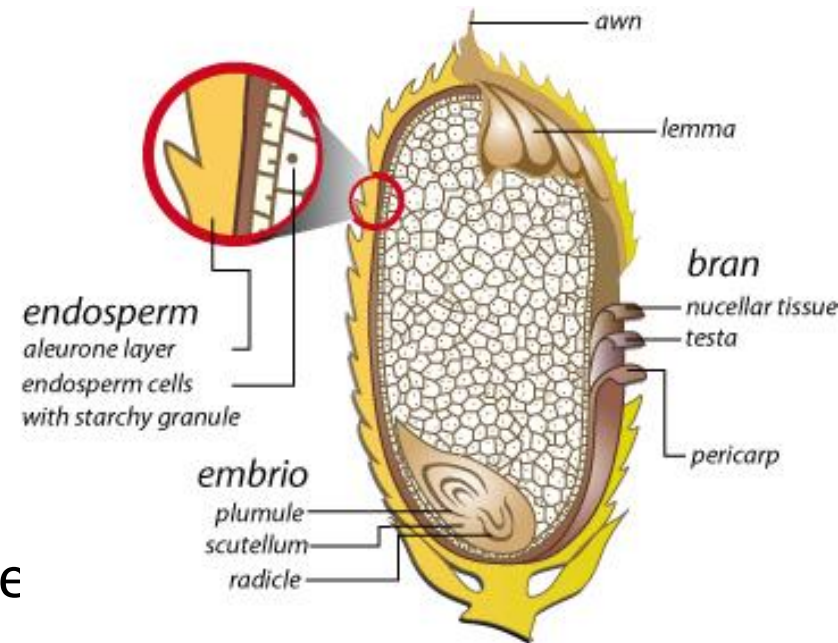
□ Exalbuminous seed:-

- * pea seed
- * attach to fruit - funiculus
- Scar on seed surface- Hilum (funiculus mark)
- close to hilum – Micropyle (H_2O absorption – germination)
- seed coat- testa & tegmen
- longitudinal ridge on seed coat – raphe
- seed whole – Kernel (no seed coat)
- 2 fleshy cotyledons
- no endosperm
- embryonal axis – plumule & radicle
- plumule & cotyledonary node – Epicotyl
- radicle & cotyledonary node - hypocotyl

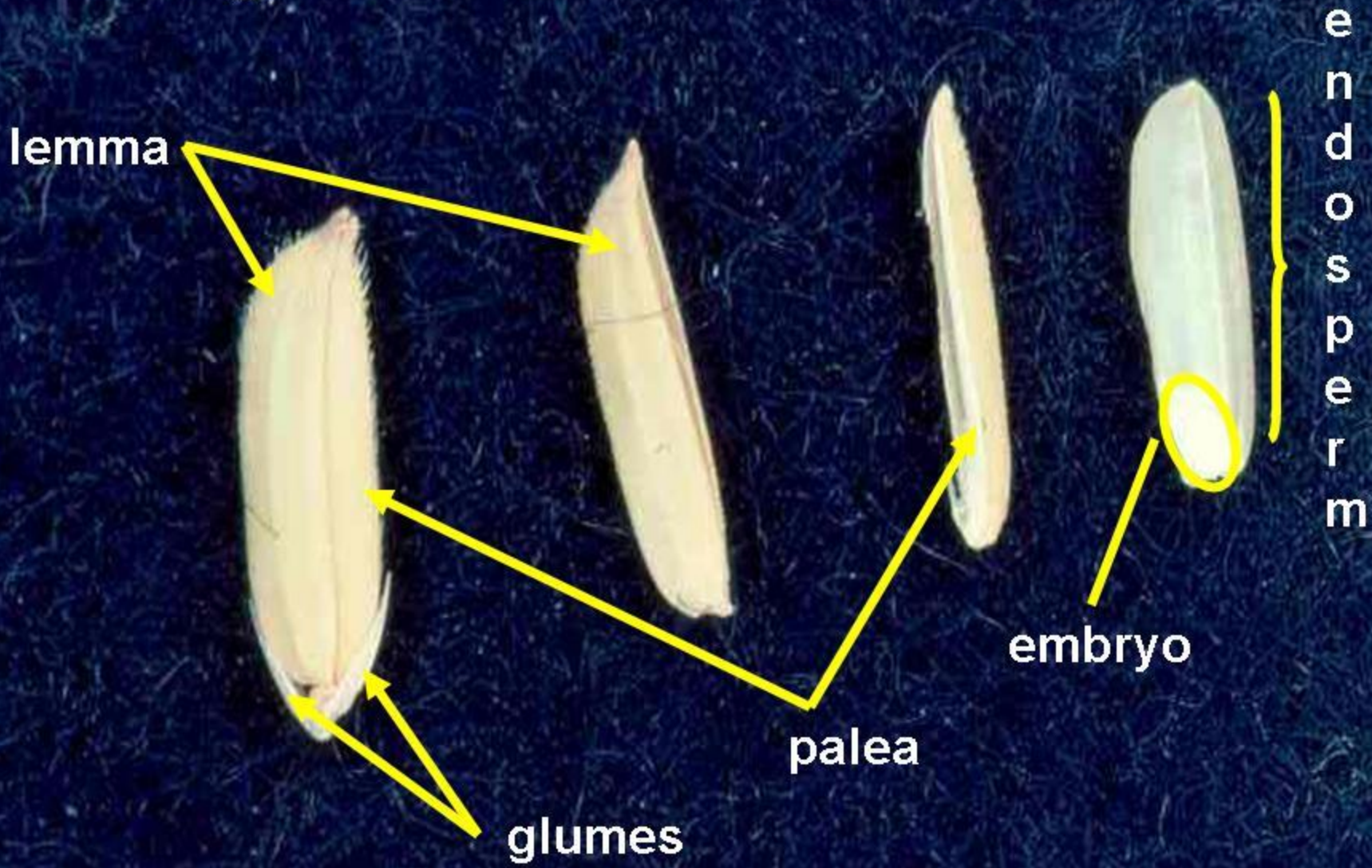


□ Albuminous seed

- most monocots
- paddy- husk (outer covering) – 2 valved
- Lemma & palea
- brown coat inside – Bran (Pericarp & seed coat)
- starchy endosperm large
- endosperm surrounded by aleurone layer
- embryo on one side of endosperm
- embryonal axis – plumule & radicle
- plumule covered by plumule sheath (Coleoptile)
- radicle – coleorhiza
- single cotyledon – absorptive & shield like- Scutellum
- it secretes enzymes for endosperm digestion
- scutellum & endosperm separated by epithelial layer
- axis b/w plumule & cotyledonary node - mesocotyl



Rough Rice Kernel Dissected



FRUIT & SEED DISPERSAL

- * dispersal for extensive spreading & establishment
- * colonization
- * prevent overcrowding
- Minimize interspecific & intraspecific competitions for abiotic factors
- dispersal by a) Explosion b) Wind c) Water d) Animals
- Wind: (Anemochory/ Anemospory)
- thin, light fruits & seeds – Orchids
- Hairy seeds (Comose seeds) – Calotropis, Alstonia
- Winged fruits – Calycopteris
- Winged seeds – Spathodea, tecoma, Plumeria
- feathery styles persistent – Clematis, naravelia

•Water (Hydrochory / Hydrospory)

- Seed coat thick for protection & prevent damage
- pericarp fibrous with air spaces for floating –
Cerbera, Coconut
- Air spaces b/w endocarp & seed –
Calophyllum
- seeds with spongy aril – water lily
- thalamus floats with seeds – lotus

• **Animals (Zoochory / Zoospory)**

- Fruits with spines & hooks – tribulus
- seeds with glandular hairs
- Coloured seeds – birds eat
- fleshy succulent edible fruits

* **Explosive bursting (Autochory)**

- Pericarp opens explosively – Clitoria, Abrus
- Explode on being touched – Impatiens, Oxalis

- Fruits under soil/ water – Carpotrophy
- maturation of such fruits in soil – geocarpy
(Arachis)
- maturation of such fruits in water – Hydrocarpy
(Eichhornia, Linaria)