Plant Morphology

• deals with the external forms of the plant.

The life cycle of higher plants including two stages:

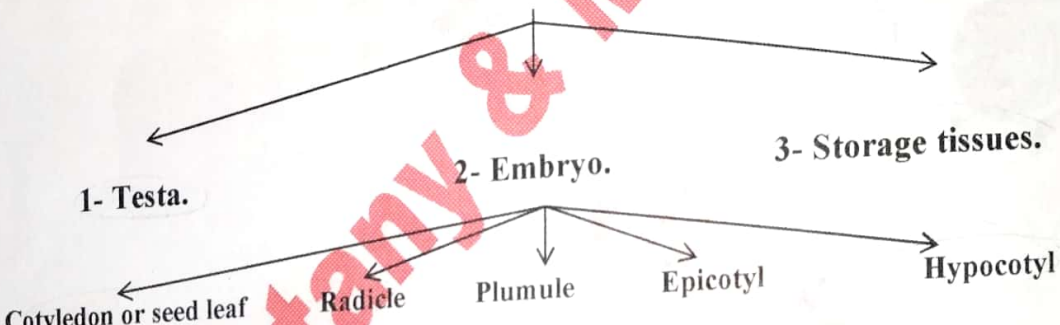
A: Dormice stage (Seed) **B: Active stage (vegetative body)**

1- Seeds

• are mature fertilized ovule.

• A seed is a small embryonic plant enclosed in a covering called the seed coat, usually with some stored food.

Seed structure (parts)



1. The seed coat (testa):

It is protective wall surrounding the embryo and storage tissue. It develops from the integument, originally surrounding the ovule.

2. The embryo is immature plant, it have:

Cotyledon or seed leaf, one in monocot, two cotyledons in dicot and two or more in gymnosperms.

Radicle is the embryonic root.

Plumule is the embryonic shoot.

Epicotyl is embryonic stem above attachment of the cotyledon(s)

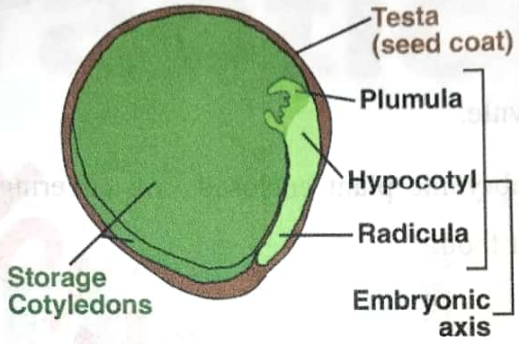
Hypocotyl is embryonic stem below attachment of the cotyledon(s)

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3. Store of nutrients, it may be:

- In angiosperms, in a tissue called the endosperm, via double fertilization, usually triploid (3n) endosperm rich in oil or starch and protein.
- In gymnosperms, the food storage tissue is part of the female gametophyte, a haploid tissue (n) contain different materials.



Pisum sativum

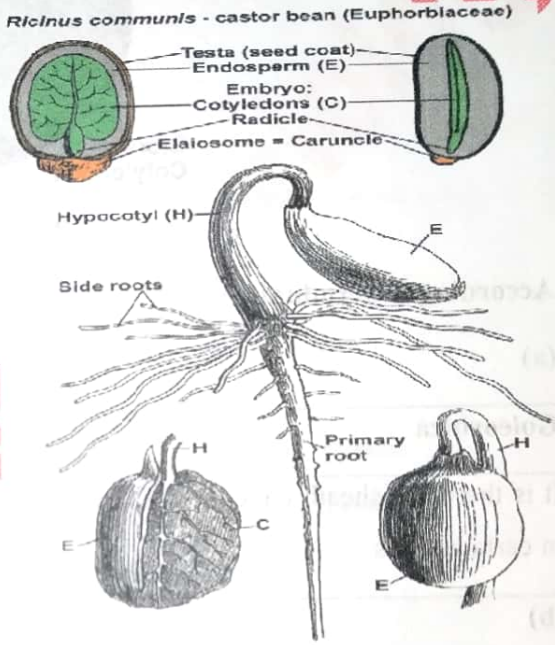
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Kinds of seeds

According to storage foods

1. Endospermic seeds

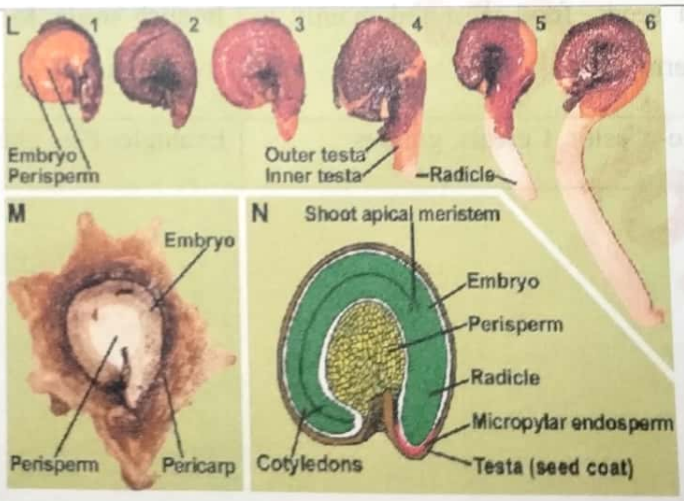
- Cotyledons thin and the endosperm is the major storage tissue. The cotyledons absorb the nutrients from endosperm.





2. Perispermic seeds Sugar beet

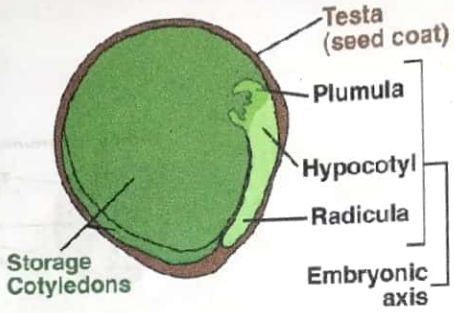
- Stored food in pericarp, a fruit tissue, and then uptake by the cotyledons.



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3. Non-endospermic seeds (legume, pea)

Stored food in cotyledons. During embryo development the cotyledons absorb the food reserves from the endosperm.



Pisum sativum

According to germination

(a)

Goleorhiza	**Coleoptile**
It is the outer sheath covering the radicle in certain seeds.	It is the outer sheath covering the plumule in certain seeds.

(b)

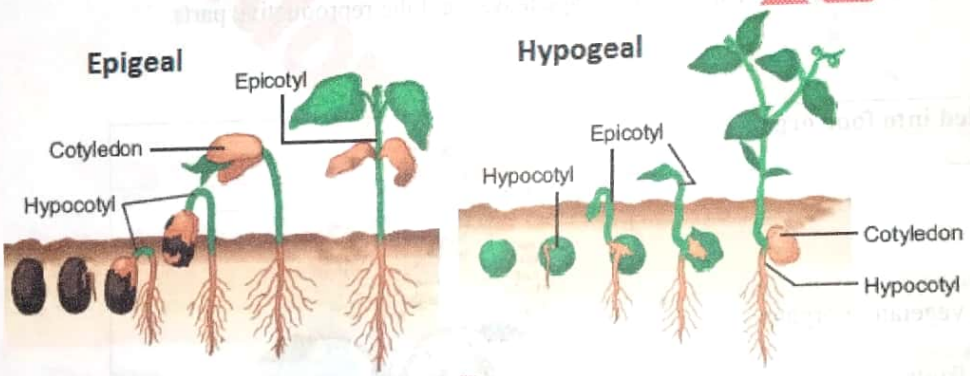
Albuminous seed	**Exalbuminous seed**
These seeds have endosperm.	These seeds lack endosperm.
In such seeds, food is stored mainly in endosperm.	In such seeds, food is stored only in the cotyledons.
Example- Castor, Cereals, grasses.	Example- Pea, gram, Lentil.

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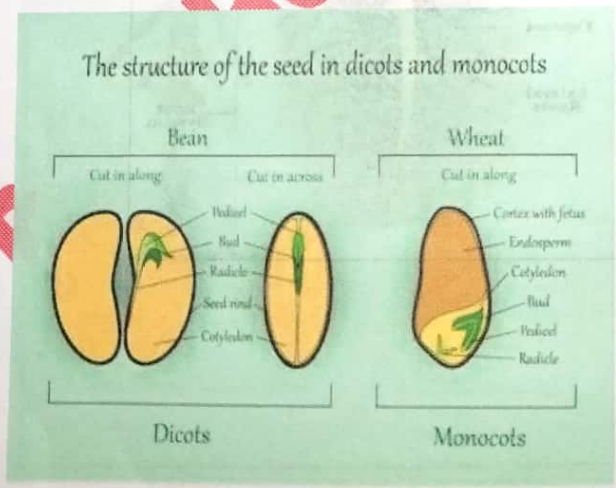
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(c)

Epigeal germination	Hypogeal germination
Here cotyledons are pushed above the soil.	Here, cotyledons remain inside the soil.
Here hypocotyl grows and elongates faster than epicotyl.	Here epicotyl grows and elongates faster than hypocotyl.
Example – Bean, cotton, castor, papaya	Example – Wheat, rice, groundnut, mango



According to number of cotyledons



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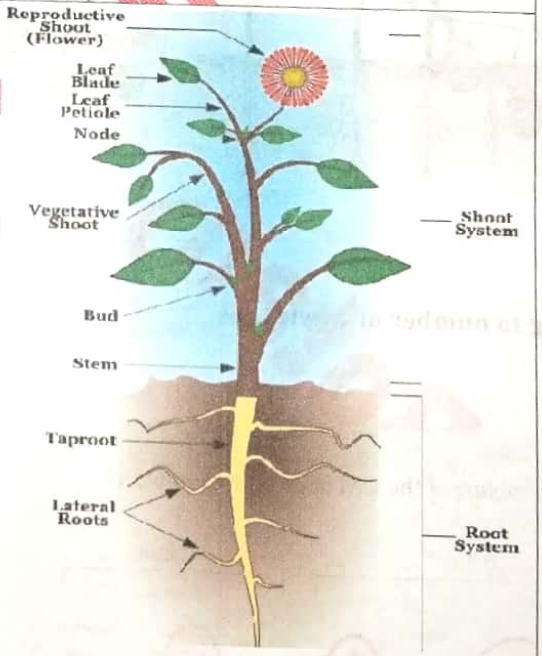
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B: Vegetative Body (2 parts)

Root system	Shoot system
• grows beneath the soil surface • consists of **primary root, lateral roots & rootlets**. • its function fixation, absorption & **some roots perform special functions** as storage, climbing,	grows above the soil surface consists of the stem (main axis) of the plant It carries the leaves the flowers and fruits. A **normal** stem is divided into **nodes** and **internodes**. • its function bearing, conduction & **Metamorphosed for special functions as storage, perennation, climbing**

and the **shoot system** which usually

grows above the soil surface and carries the foliage leaves and the reproductive parts.

Plant is divided into four organs:	
1. Root 2. Stem 3. Leaves and vegetative organs. 4. Flower and fruits.	

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The root is usually differentiated into the following zones:

1. **Growing apex:** active promeristem at tip, consists of meristematic tissues, covered by calyptra.
2. **Zone of elongation:** rapid elongation zone helps root to grow.
3. **Zone of absorption (root hairs):** fine white hairs at all sides for absorption of water and solutes.
4. **Bare zone:** oldest root hairs fall leaving region bare.
5. **Permanent zone (lateral roots):** Lateral roots arise endogenously from the vascular cylinder branch into smaller rootlets.

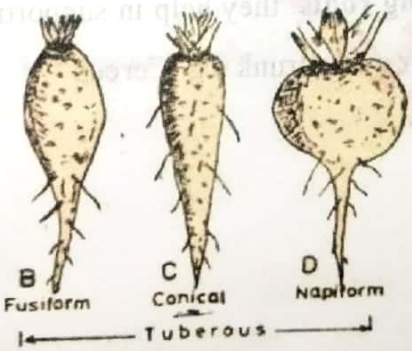
Types of Roots

I. Tap roots جزور وتدية

Normal (non-tuberous)

II. Adventitious roots جزور عرضية

tuberous_ متدرنة

• store normal amounts of food. • The root is cylindrical in shape with broad base and a tapering apex. e.g. Cotton root or Ricinus root.  	• store excessive amounts of food. • According its shape they are: **1-fusiform** e.g. Raphanus sativus (Radish). **2- conical** e.g. Daucus carota (Carrot). **3-napiform** e.g. Brassica rapa (Turnip). 

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II. Adventitious roots

They do not arise from the radicle but they usually arise from other parts such as the base of the stem or lower surface of leaves.

Types of adventitious roots:

1. Fibrous roots: They are fine thread- like roots common in the family Gramineae

e.g. **Cynodon dactylon.**

2. Prop roots: They develop from the lower nodes of long stems e.g. Zea mays (Maize).

3. Aerial roots: They arise from the lower surface of some large trees e.g. Ficus benghalensis.

4. Pillar roots: When some of the prop roots reach the soil surface and penetrate inside the soil

e.g. Ficus benghalensis.

5. Tuberous roots: store excessive amounts of food

e.g. Ipomoea batatus (Sweet potato).

6. Climbing roots: they help in supporting the plant to a wall or a tree trunk e.g. Cereus

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The Shoot System

Description of Stem

1. Habit

1. Herb عشبي	2. Shrub شجيرة	3. Tree شجري
كمية قليلة من الانسجة اللجنين مثل نبات البرسيم e.g. Trifolium (clover).	كمية كبيرة من الانسجة اللجنين ولكن الشجيرة ليس لها جذع رئيسي والافرع قريبة من سطح التربة واقل في الطول من الشجرة مثل الورد Rosa	كمية كبيرة من الانسجة اللجنين و لها جذع رئيسي يسمي Trunk مثل شجر الكافور Eucalyptus.

2. Nature

1. Erect stems ساق قائمة

لها القدرة علي حمل الاوراق والفروع والازهار والثمار لانها تحتوى علي كمية كافية من الانسجة الخشبية التدعيمية

e.g. Gossypium, Vicia faba.

مثل القطن والفول

2. **Weak stems** ساق ضعيفة

غير قادرة علي حمل الاوراق والفروع والازهار والثمار لانها لا تحتوى علي كمية كافية من الانسجة الخشبية التدعيمية

Weak stems

a. Climbing stems متسلقة

1- **by twining** الالتفاف e.g. Convolvulus

2- **by tendrils** المحاليق e.g. Vitis or e.g. Pisum

3- **by prickles** بالاشواك e.g. Rosa

4- **by adventitious roots** الجذور العرضية e.g. Cereus.

b. Creeping stems زاحفة

1- **Prostrate** منبطحة

2- **Running** جاري

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3. Shape الشكل

- Cylindrical إسطواني
- angular مضلع
- flattened مسطح

4. Surface السطح

- Smooth (glabrous) ناعم
- Rough خشن
- Hairy شعرى
- prickly شوكي

5. Internal structure التركيب الداخلي

- Solid مصمت: with a pith e.g. Salvia
- hollow اجوف: without a pith e.g. Vicia faba.

6. Dwarfness التقزم (القصر)

- Normal ساق طبيعية: divided into nodes and internodes
- Dwarf (discoid stem) ساق متقزمة قرصية: not differentiated into nodes and internodes
  مثل البصل و الفجل

7. Buds البراعم: محور قصير لا يتميز الى عقد وبين عقد

Classification

1. Terminal (apical) bud قمي او طرفي
2. Lateral (axillary) buds جانبي
3. Adventitious buds عرضي

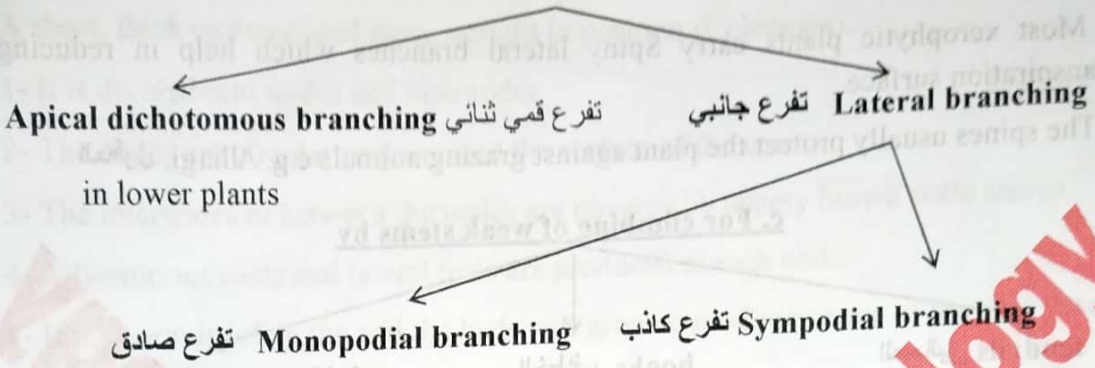
1. Position المكان
2. development التطور
3. duration فترة الوجود

- Leafy or branch bud برعم ورقي
- Flower bud برعم زهري
- Mixed bud برعم خليط

- Summer bud
- Winter bud

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8. Branching (due to activity of buds)



9. Metamorphosis التحورات

• Stems metamorphosed to perform functions other than their normal functions as

a. For assimilation التمثيل الضوئي

Phylloclades ساق عديد السلميات

• The stem is flattened.

• with several internodes.

• green and leaf- like. e.g. Ruscus السفندر

Succulent stems: ساق عصارية

Phylloclades of are flattened, green and fleshy being photosynthetic and store water and food.

• The lateral buds are metamorphosed to spines.

e.g. Opuntia التين الشوكي

Cladode ساق وحيد السلمية

• flattened.

• with a single internode.

• green and each cladode is represented by a single internode

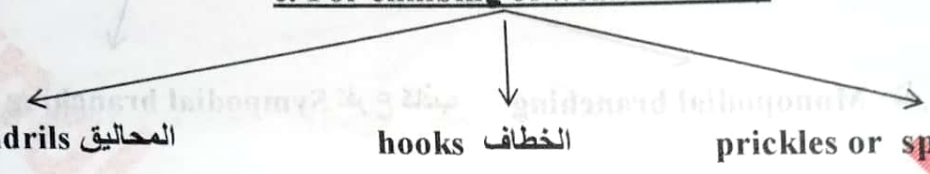
e.g. Asparagus. الكشك ألماظ

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b. For reduction of the transpiring surface and protection

- Most xerophytic plants carry Spiny lateral branches which help in reducing transpiration surface.
- The spines usually protect the plant against grazing animals e.g. Alhagi. العاقول

c. For climbing of weak stems by



d. For perennation التعمير, storage التخزين and vegetative reproduction التكاثر الخضري

1• Rhizome:

A horizontal underground stem growing horizontally beneath the soil surface.

e.g. Cynodon dactylon.

1- It is usually branched and divided into nodes and internodes.

2- Scale leaves and adventitious roots arise from the nodes.

3- Aerial green shoots arise from the upper surface of the rhizome at the nodes.

4- Branching of the rhizome is mostly sympodial.

2• Tuber:

It is an enlarged portion of an underground perennial stem e.g. potato.

1- The surface of the tuber is full of shallow depressions known the **eyes**.

2- The eyes represent nodes of the underground stem.

3- The eye is surrounded by very small scale leaves & axillary buds found in center.

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3• Corm:

A short, thick underground stem, upright in position (Colocasia).

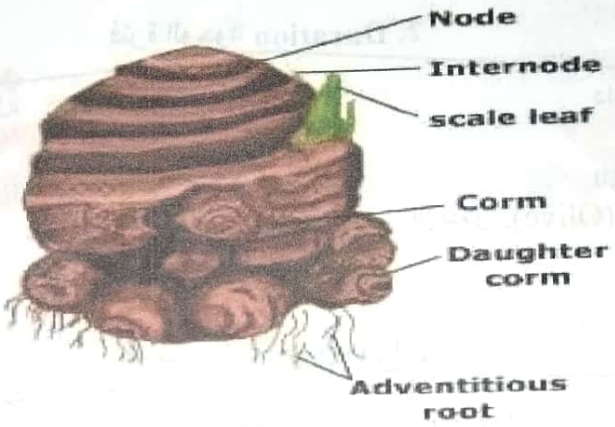
1- It is divided into nodes and internodes.

2- The nodes are circular rings around the surface of the corm.

3- The internodes in between the nodes are covered by papery brown scale leaves.

4- Adventitious roots and lateral buds are produced at each node.

5- If the corm is left in the soil the buds will grow to produce corms of the next year.



4• Bulb:

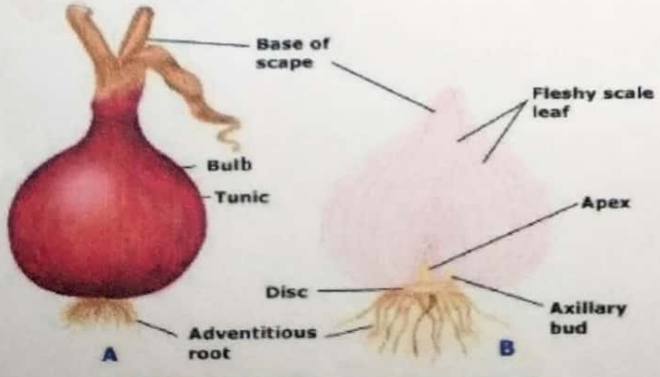
It is an underground short discoid stem composed of enlarged and fleshy leaf bases which are termed the scales.

1- Food is stored in the scales e.g. onion.

2- The discoid stem carries a terminal bud on its upper surface which is surrounded by the scales.

3- axillary buds present in the axile of the scales.

4- The bulb of garlic is divided into small **bulbils**.



A. Tunicated bulb of onion B. L.S. of bulb

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II. The Leaf

1. Insertion المنشأ

Radical جزرية

arise from discoid stem (Onion and radish).

Cauline ساقية

arise along main axis of stem at nodes

2. Duration فترة الوجود

Evergreen دائمة الخضرة

Leaves remain through the whole year green (Olive). الزيتون

Deciduous متساقطة

Leaves fall down in autumn or winter (Vitis). العنب

3. Arrangement الترتيب

1. **Alternate** متبادلة

one leaf at each node

2. **Opposite** متقابلة

Two leaves at each node

- **Superposed فوق بعضه**

Successive pairs of leaves over each other

- **Decussate متصالب**

Successive pairs of leaves at right angles to each other

3. **Whorled (Verticillate)** محيطية

more than 2 leaves at each node.

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4. Leaf base is the part of the leaf which is attached to the stem at the node.

a. **Exstipulate** عديمة الاذينات no appendages

b. **Stipulate** ذات أذينات

with two lateral appendages.

1. **Normal**
no swollen than petiole.

2. **Pulvinate** منتفخة
swollen than petiole.

3. **Sheathed** غمدية
a broad flattened base

Stipules may be ordinary, leafy, spiny, tendral, hairy

5. Leaf petiole عنق الورقة a cylindrical portion between the leaf base and the blade

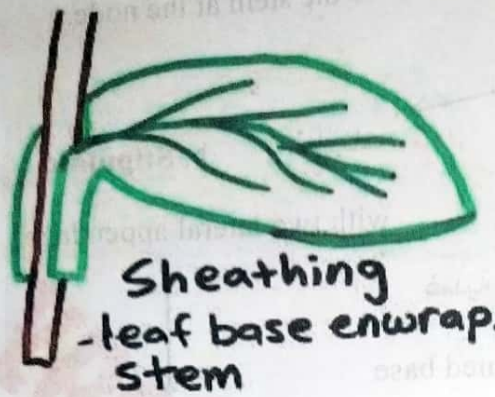
1- Petiolate or **stalked leaves** معنقة
leaves with a petiole

2- Sessile جالسة
with no petiole

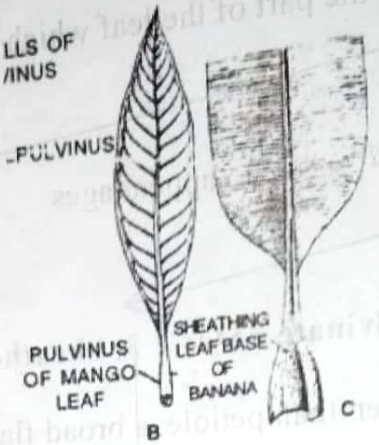


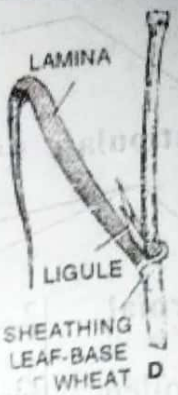


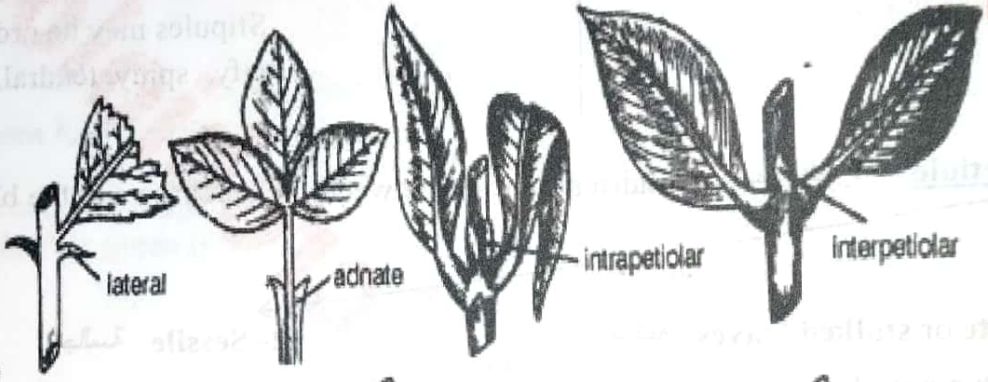
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Sheathing
-leaf base enwraps stem



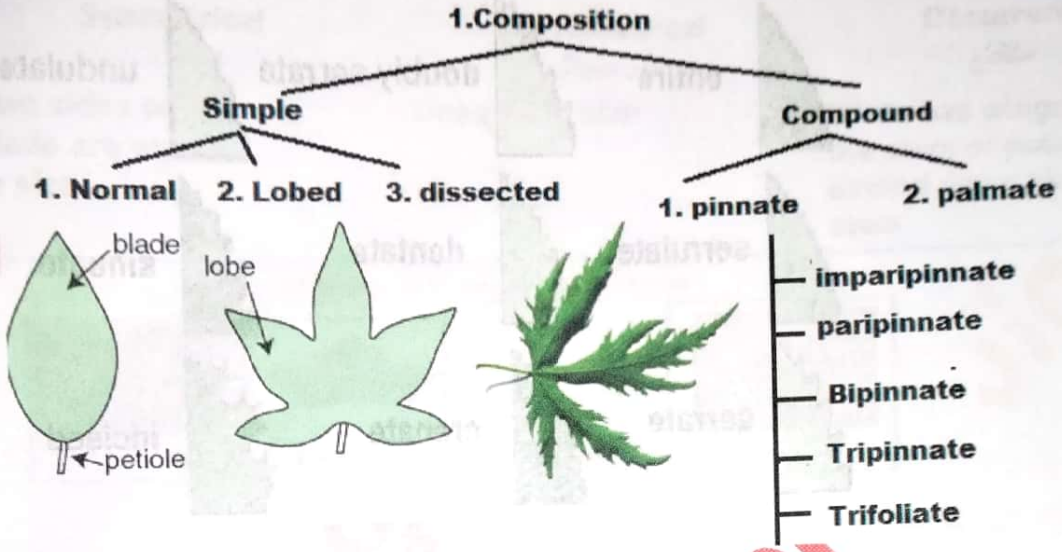




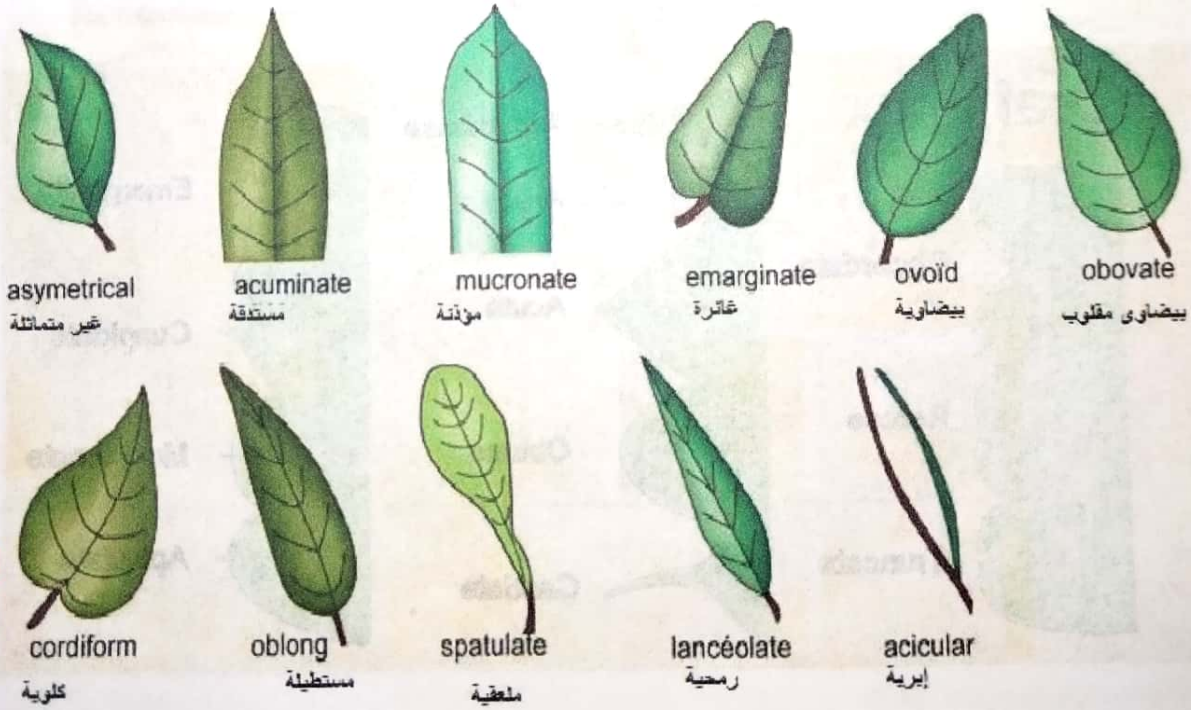


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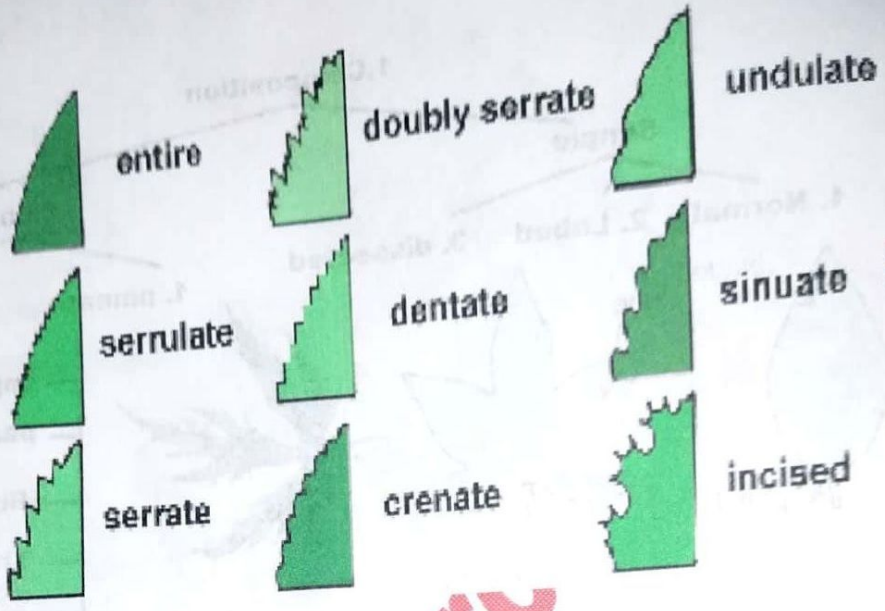
6. Leaf blade: green photosynthetic flattened part of the leaf.



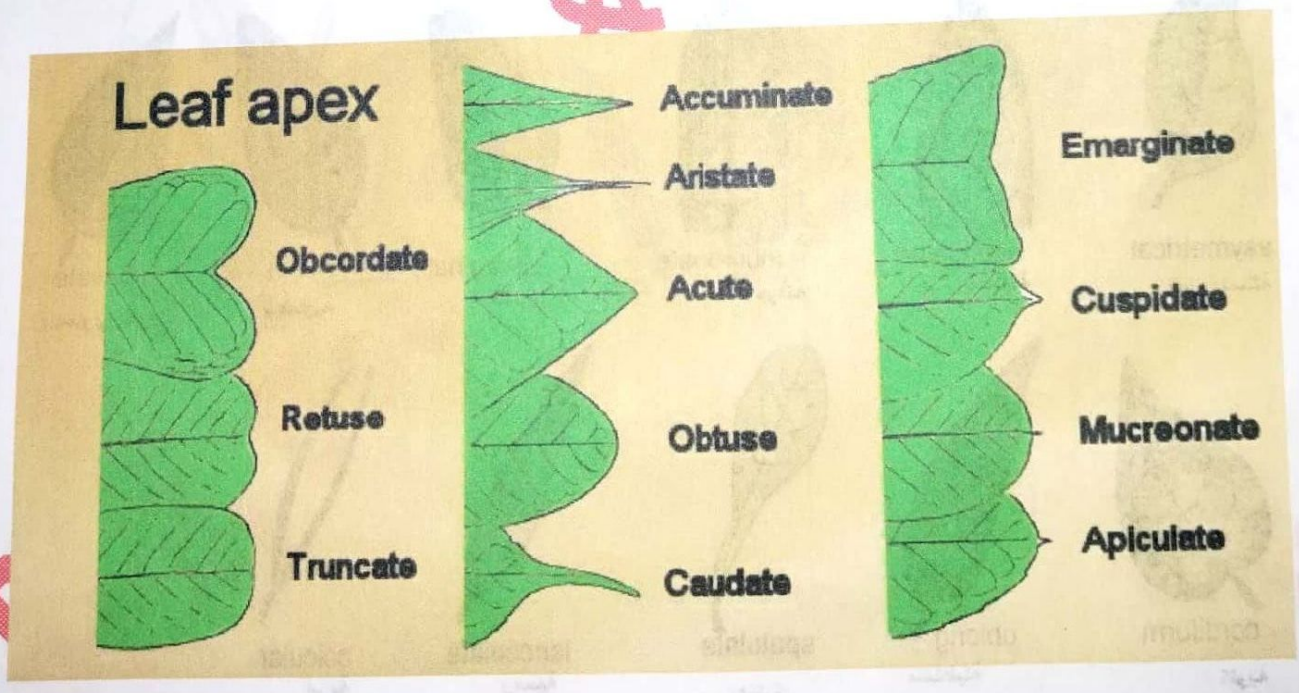
2. Shape



3. Margin الحافة



4. Apex القمة



5. Base

Symmetrical متماثل

Two sides of the blade are equal in size

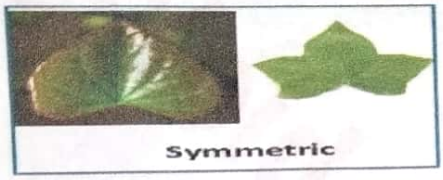
Asymmetrical غير متماثل

Unequal in size

Decurrent متقطع

Blade has wings around the stem or petiole & extend down along the stem

Base of the lamina







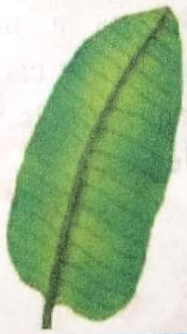
6. Venation

- **Reticulate** شبكي
  - **Pinnate** ريشي
  - **Palmate** راحي
- **Parallel** متوازي
  - **Longotudinal (Basal)**
  - **Transverse (Costal)**









7. Metamorphosis:

The leaf may become modified to perform special functions.

1- For reduction of transpiring surface:

The leaves modified into scales to reduce the transpiring surface.

e.g. Ruscus

2- For protection:

The leaves and/or stipules become spiny for protection of the plant against grazing animals.

3- For climbing:

The leaf or stipules become spiny or tendril for climbing

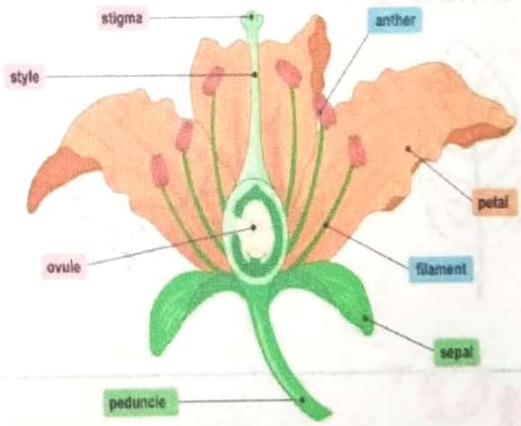
e.g. Lathyrus plant.

4- For storage:

In onion the white fleshy leaves store food and water.

5- For reproduction:

The flower is a modified stem, its receptacle usually carries sepals, petals, stamens, and carpels which are actually modified leaves.



8. Heterophylly:

The same plant carries two or more different forms of leaves e.g. Vicia seedling.

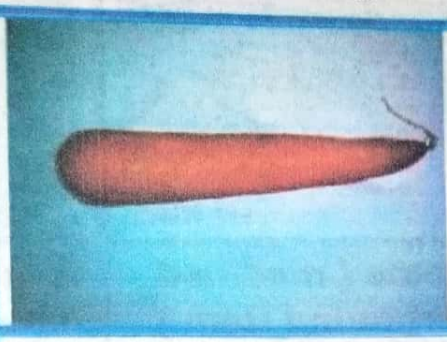
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Scheme Morphology



Normal tap root



Conical tuberous tap root



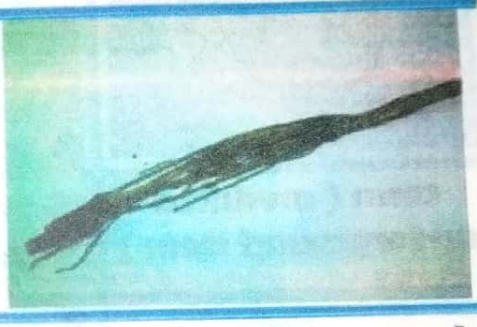
Napiform tuberous tap root



fusiform tuberous tap root



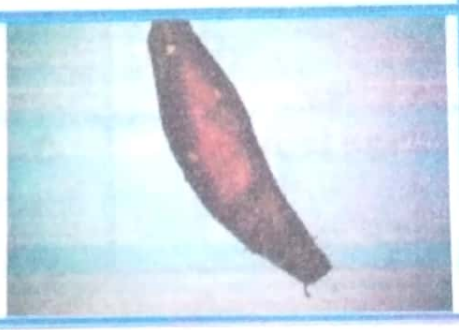
Prop adventitious root



aerial adventitious root



climbing adventitious root



tuberous adventitious root



Leafy stem (phylloclade e.g *Ruscus*)



Succulent stem (phylloclade e.g *Opuntia)*



Leafy stem (cladode e.g *Asparagus*)



Climbing stem



Rhizome (modified underground stem)



Rhizome (modified underground stem)



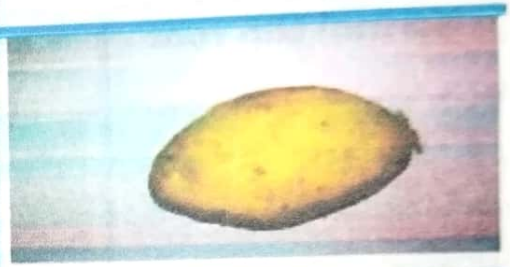
Spiny stem (e.g *Alhagi*)



corm (modified underground stem)



Garlic bulb (modified underground stem)



tuber (modified underground stem)



Storage leaves



Onion bulb (modified underground stem)

1- Root system:

Always absent but if present is called **Normal tap root**

2- Shoot system

a- Stem

1- Habit: Herb or woody

2- Nature: Erect or weak

3- shape: Cylindrical

4- surface: Smooth or rough or spiny

5- internal structure: Hollow or solid

6- Colour: green or greenish or brown

7- Dwarfness: Normal or dwarf

8- Buds: according to position → Apical bud & lateral bud.

Duration → Summer bud or winter bud.

9- Branching: Unbranched or lateral monopodial

10- Metamorphosis: absent or present.

Note that:

1 4 5 6 9

Herb → Smooth → Hollow→ green → unbranched

Woody → rough → Solid → Brown- lateral monopodial

* shape usually → cylindrical

*Buds usually according to position → Apical bud & lateral

According to duration→ Summer bud.

* (Nature) Erect → Metamorphosis → Absent.

Weak → Metamorphosis → present.

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b- Leaf:

1- Insertion: Cauline or Radical

2- Duration: Evergreen or Deciduous

3- Arrangement: Alternate, opposite, whorled

Superposed ← → decussate

4- Leaf base: Exstipulate or stipulate.

5- Leaf petiole: petiolate or sessile.

6- Leaf Blade:

a- Composition: Simple or Compound → pinnate / palmate

b- shape: ovate or lanceolate

c- Margin: Entire, serrate, dentate.

d- Apex: Acute, acuminate, notched

e- Base: Symmetrical or asymmetrical.

f- Venation: Reticulate pinnate or reticulate palmate.

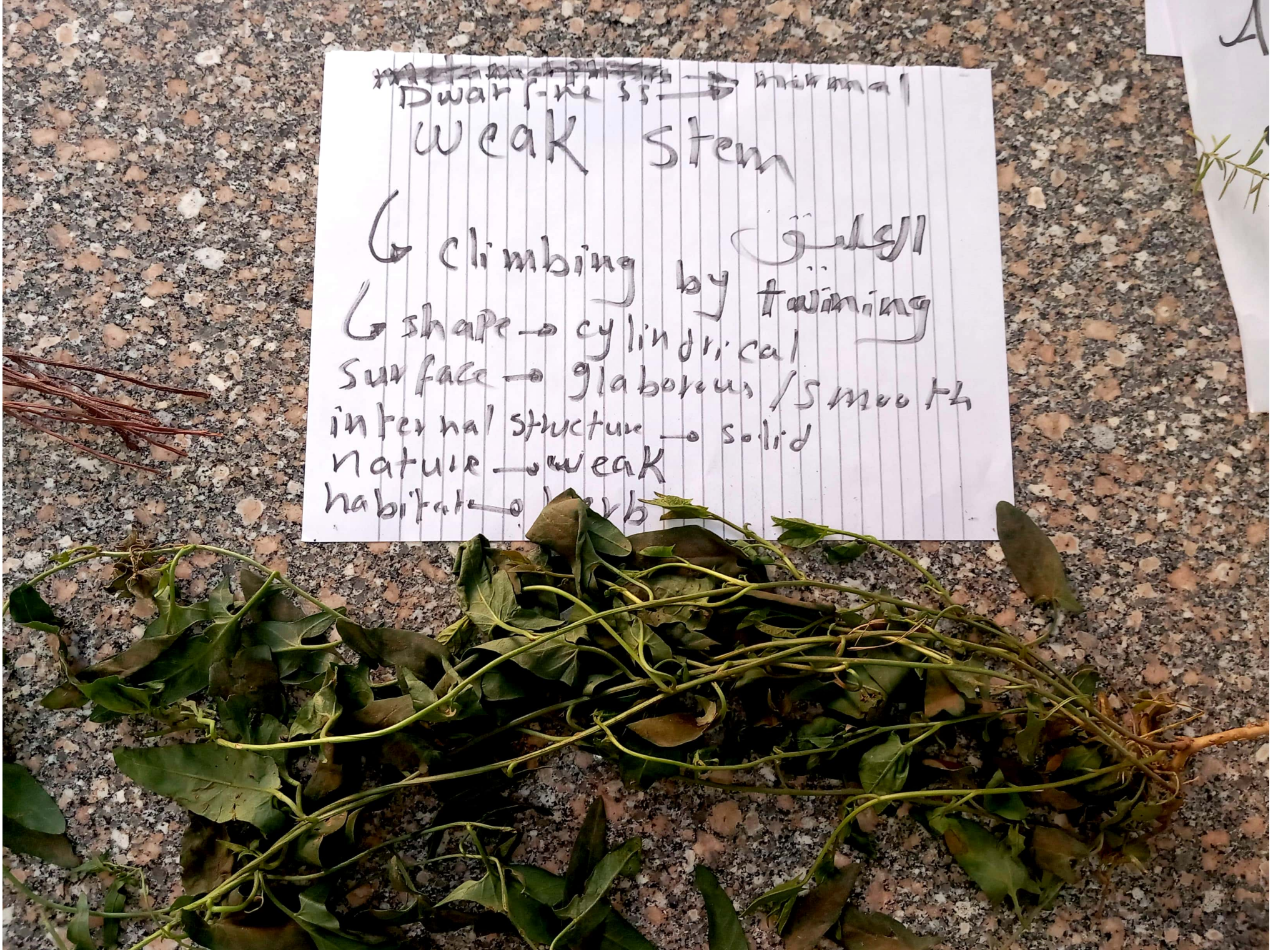
7- Metamorphosis: Absent or present.

8- Kinds of leaves: foliage leaves

9- Heterophylly: Absent

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Tuberous tap root

Napiform

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Adventous
Climbing
root

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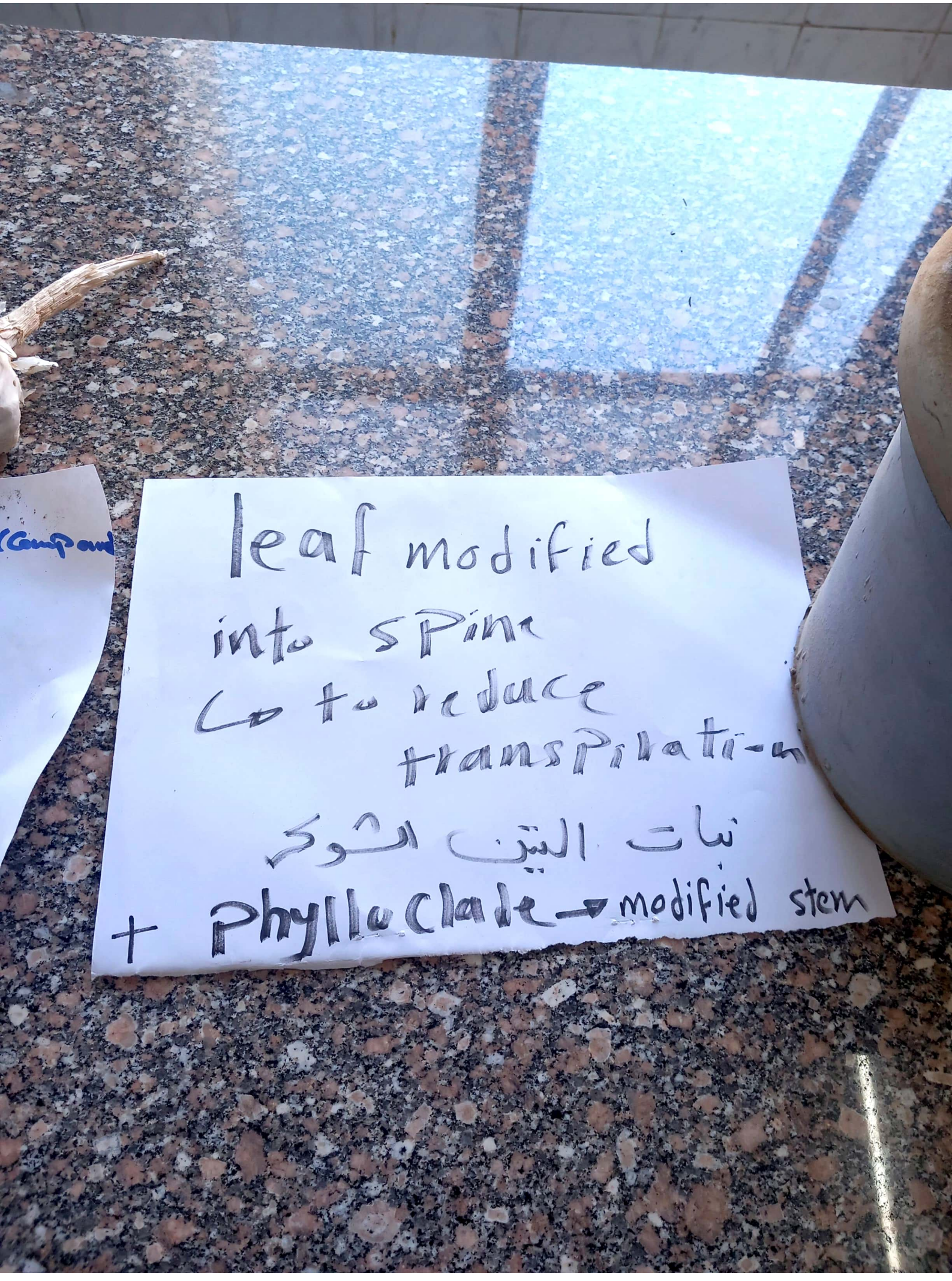
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Prop adventious root

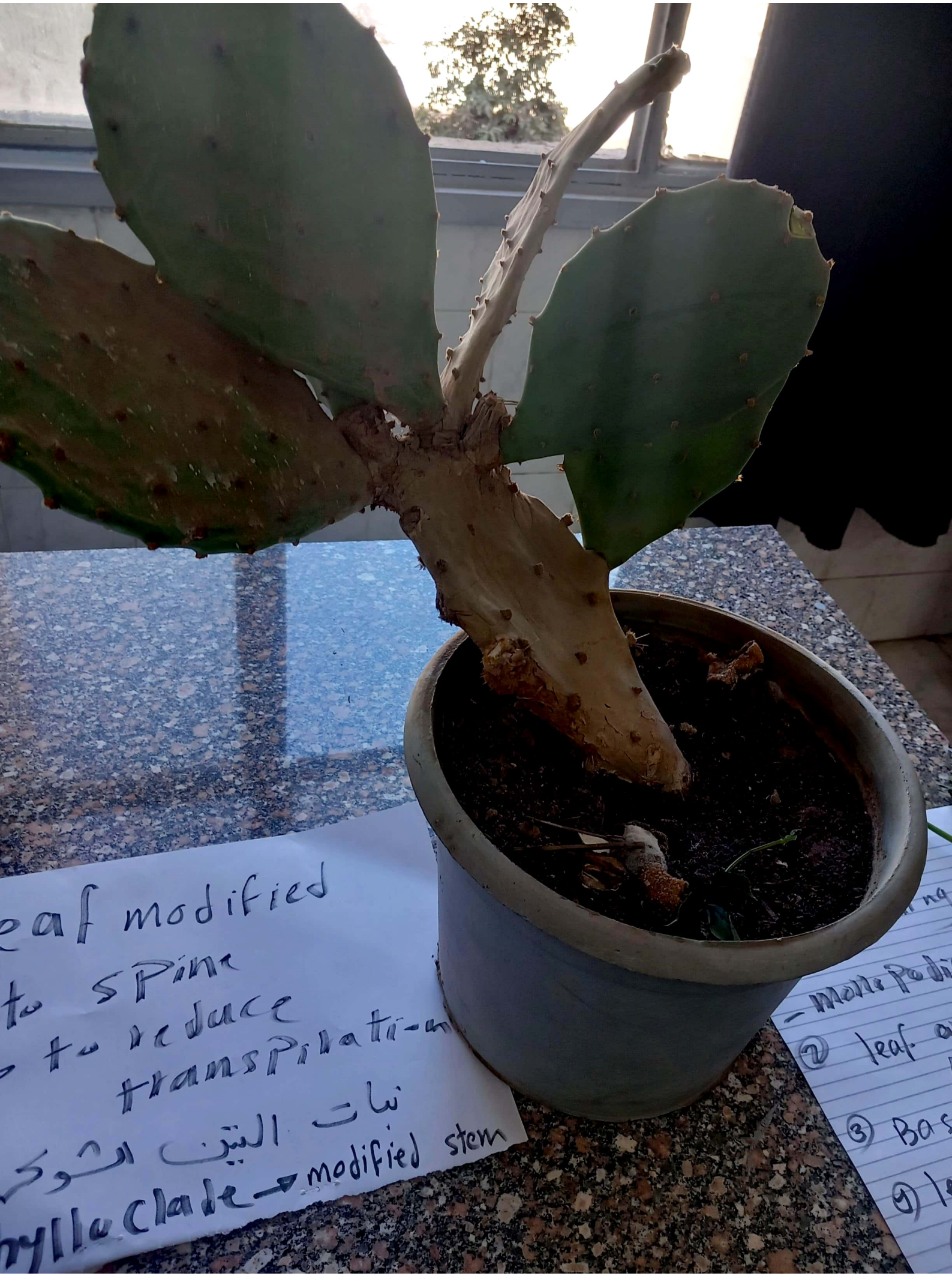




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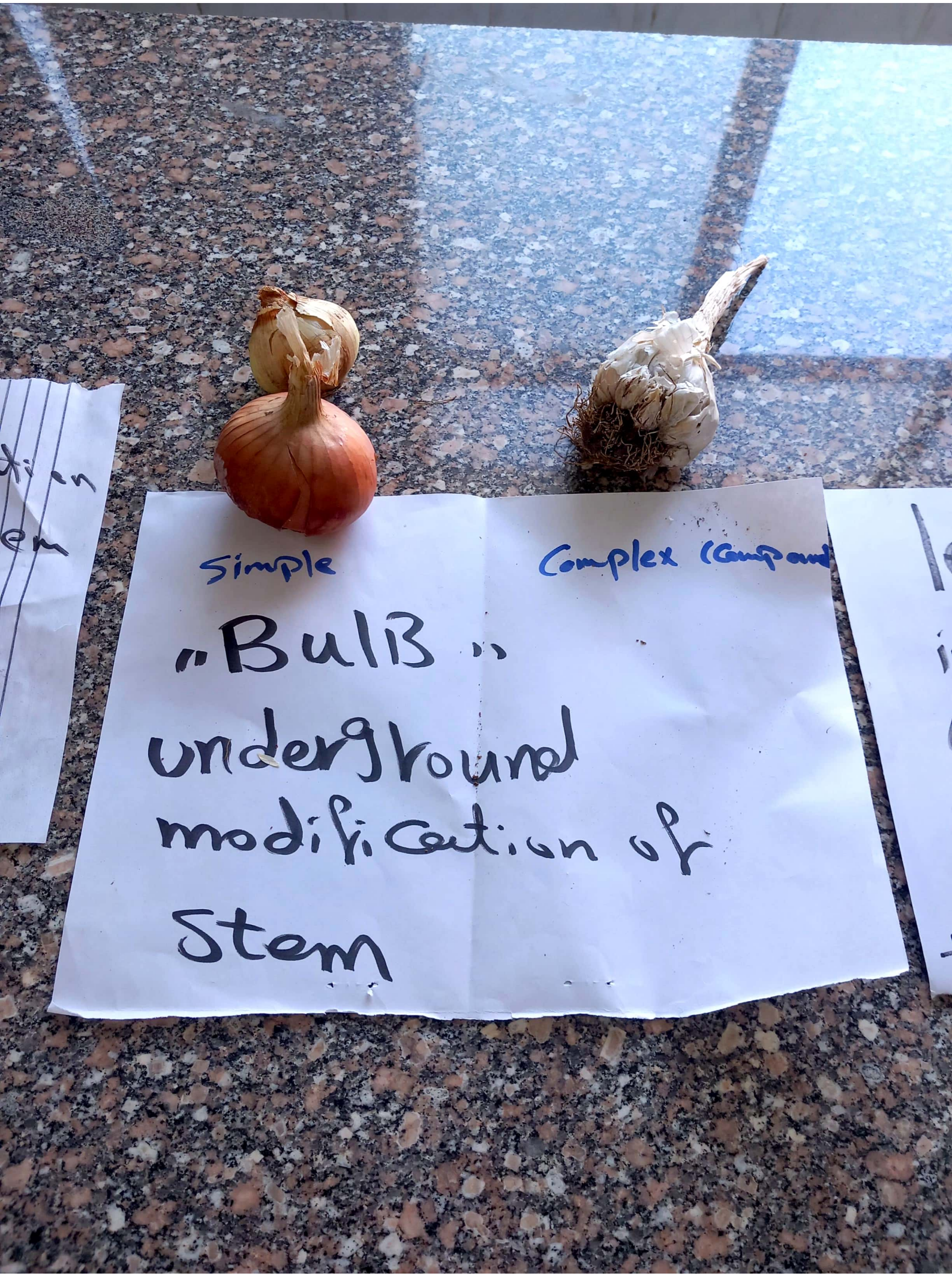
Underground modification of stem.

Rhizome

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Underground Modification
"metamorphosis" of
Stem

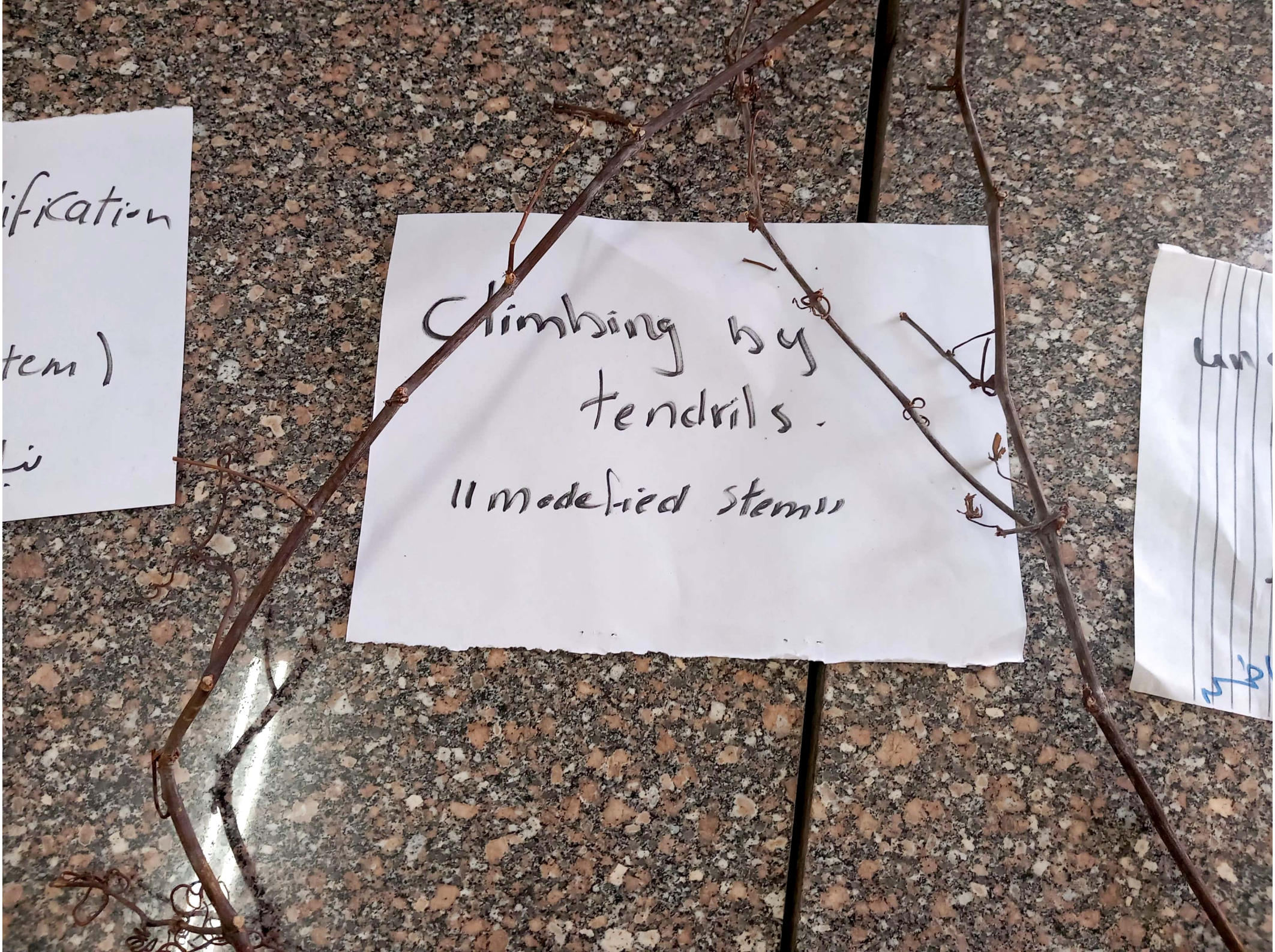
Tubers "tuberous"

Potato.

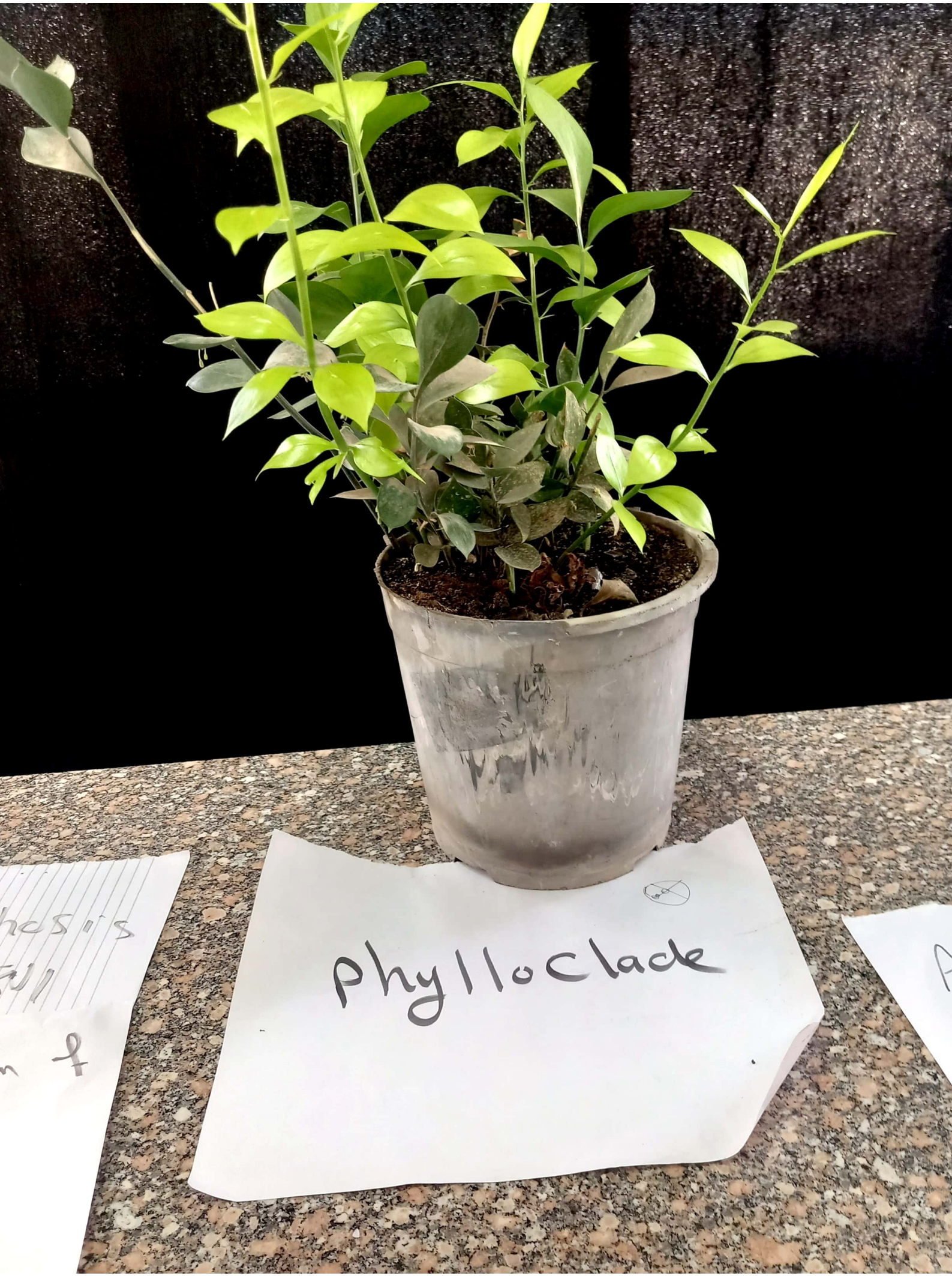
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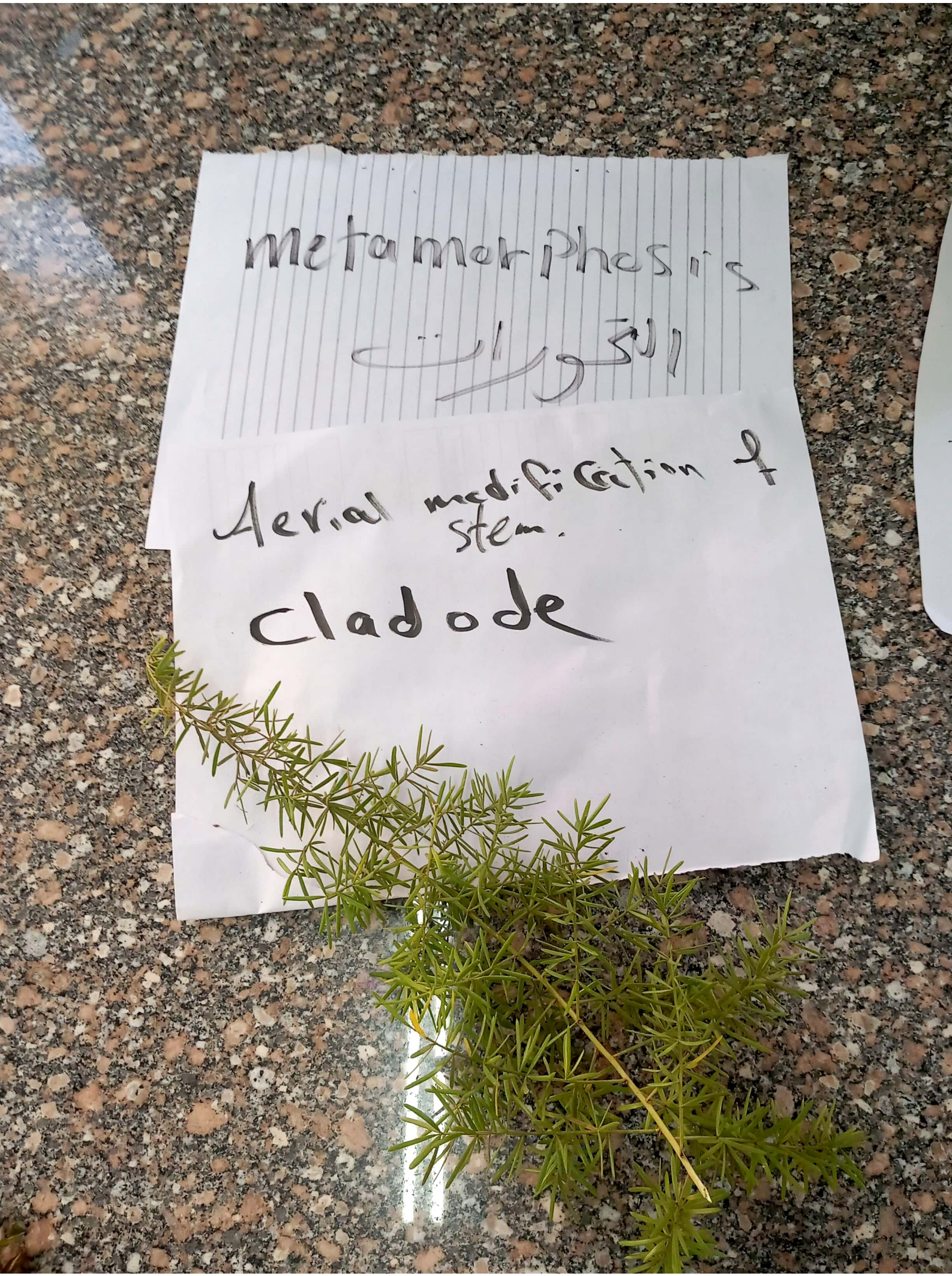
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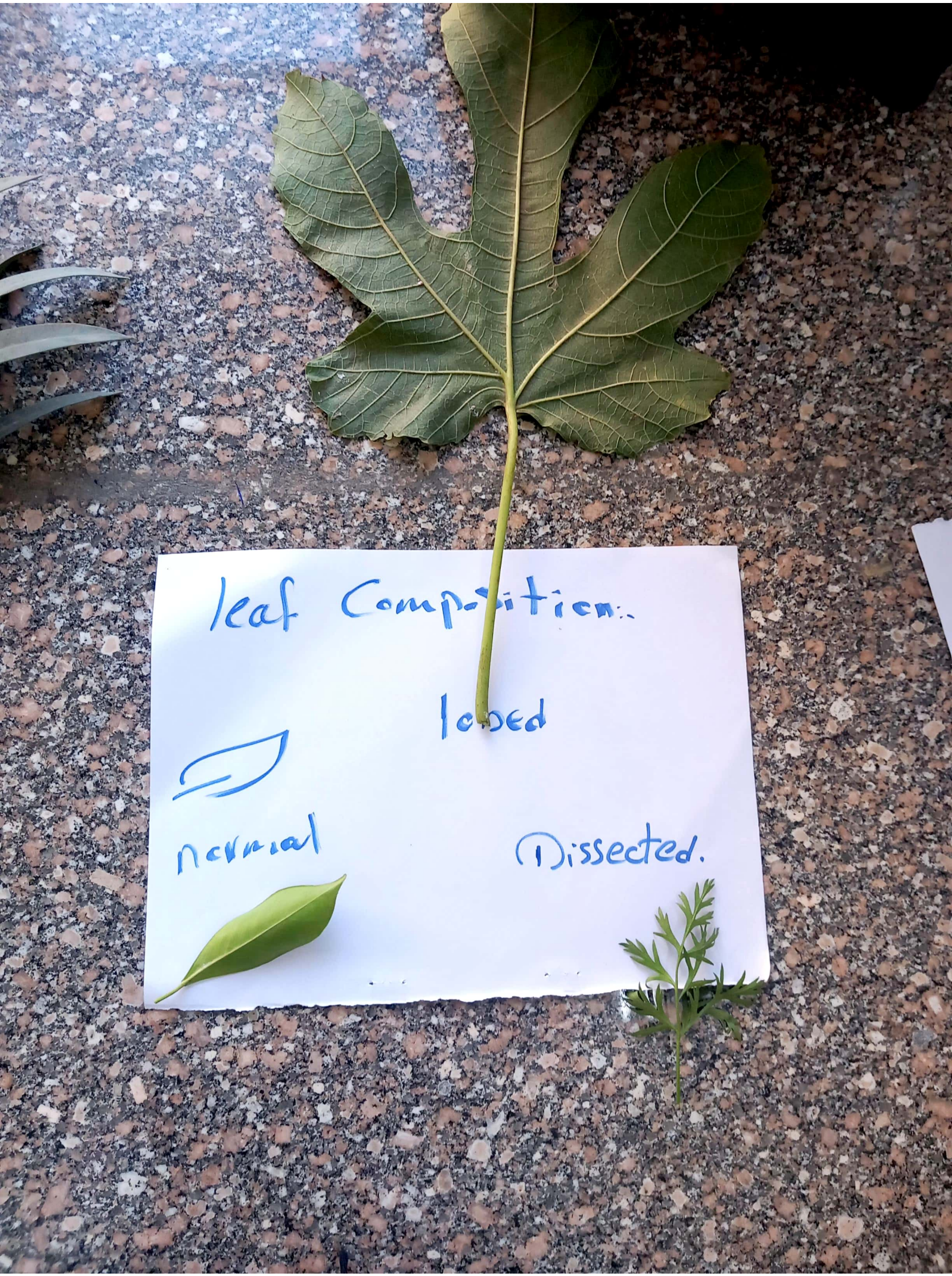
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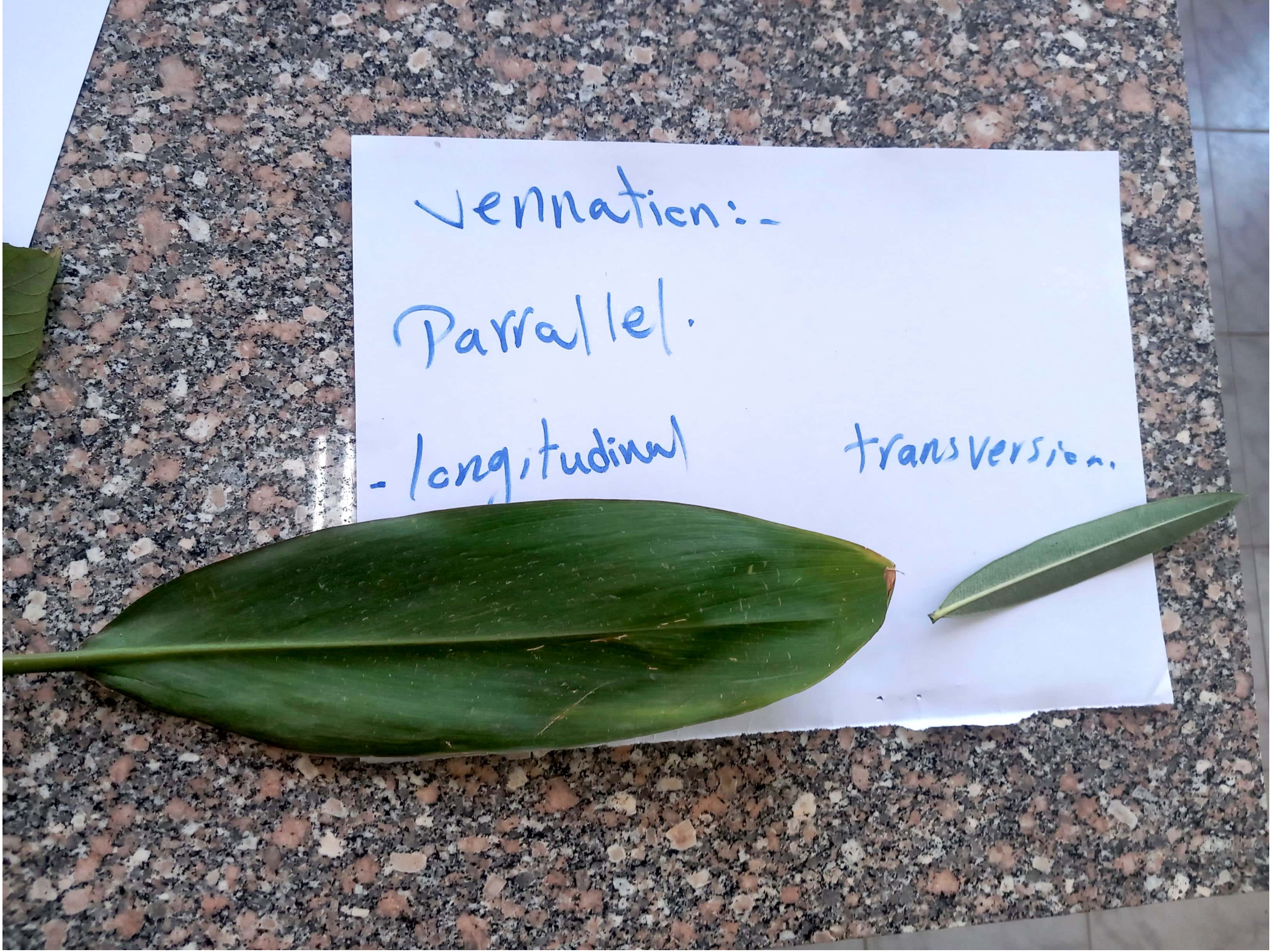
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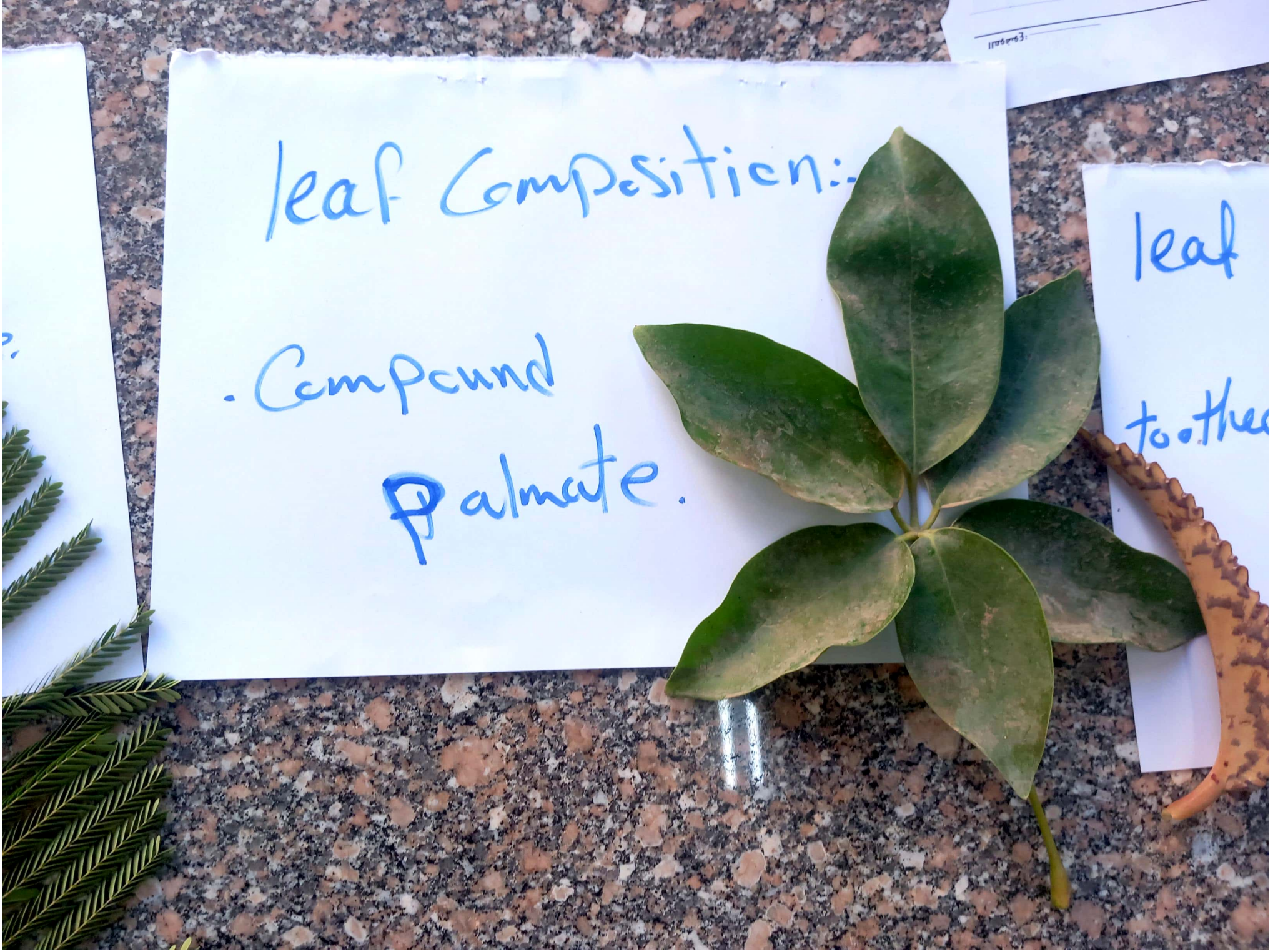
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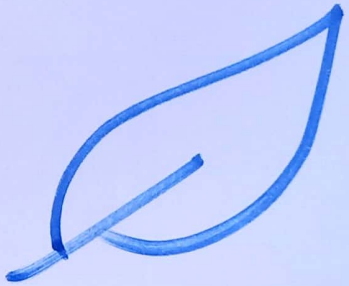
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Base of lamina.

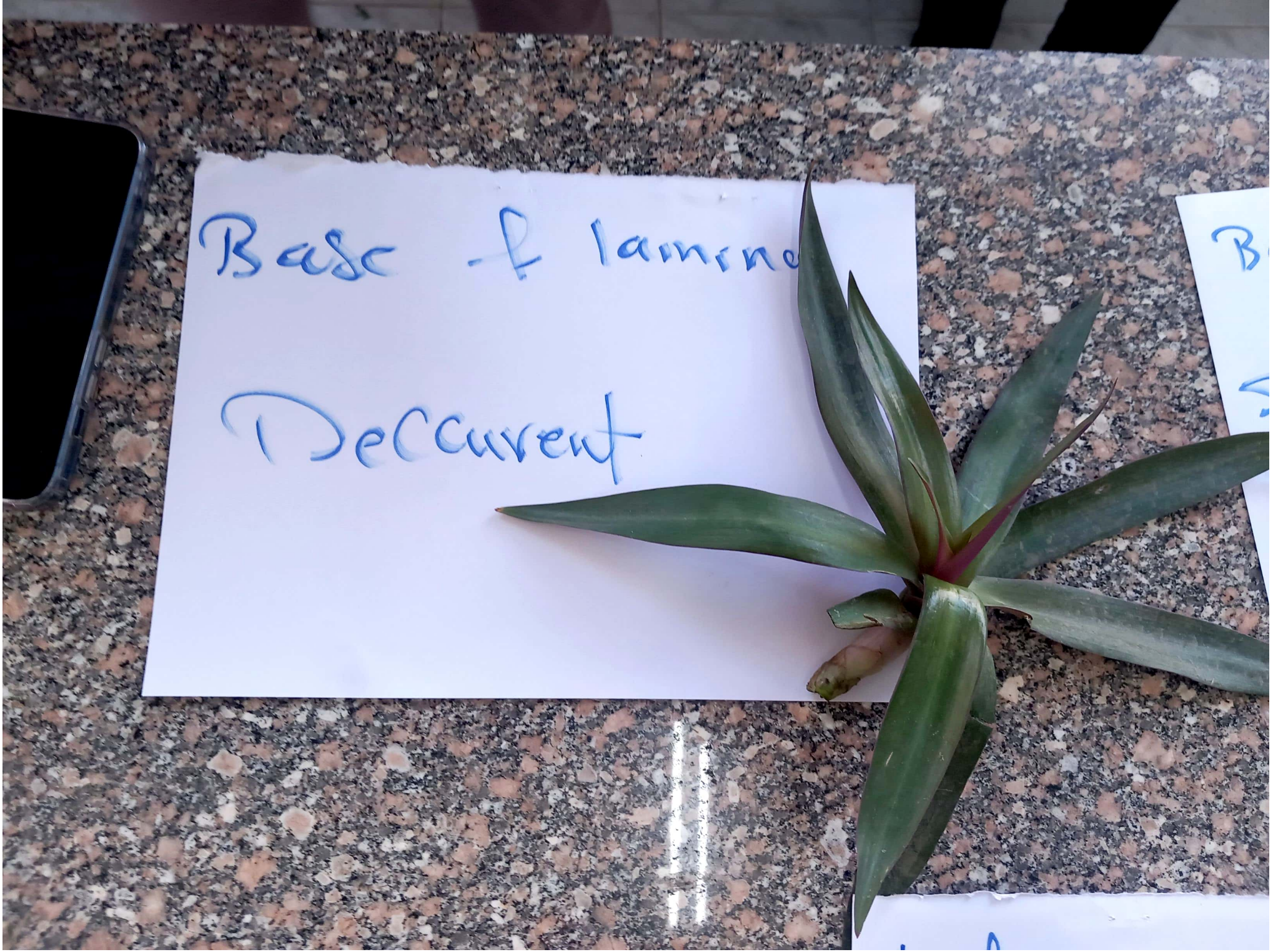
Symetrical

asymetrical.

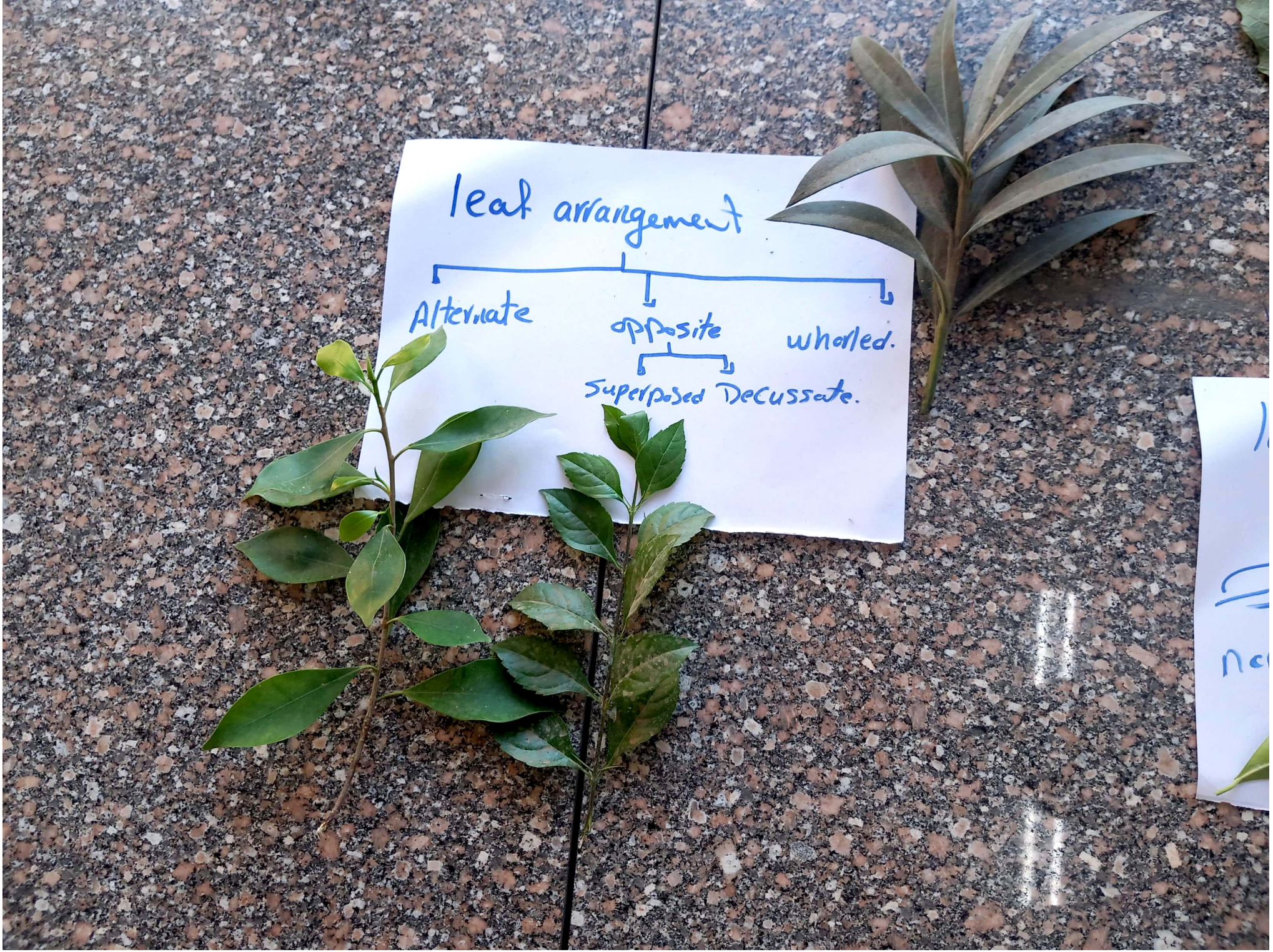




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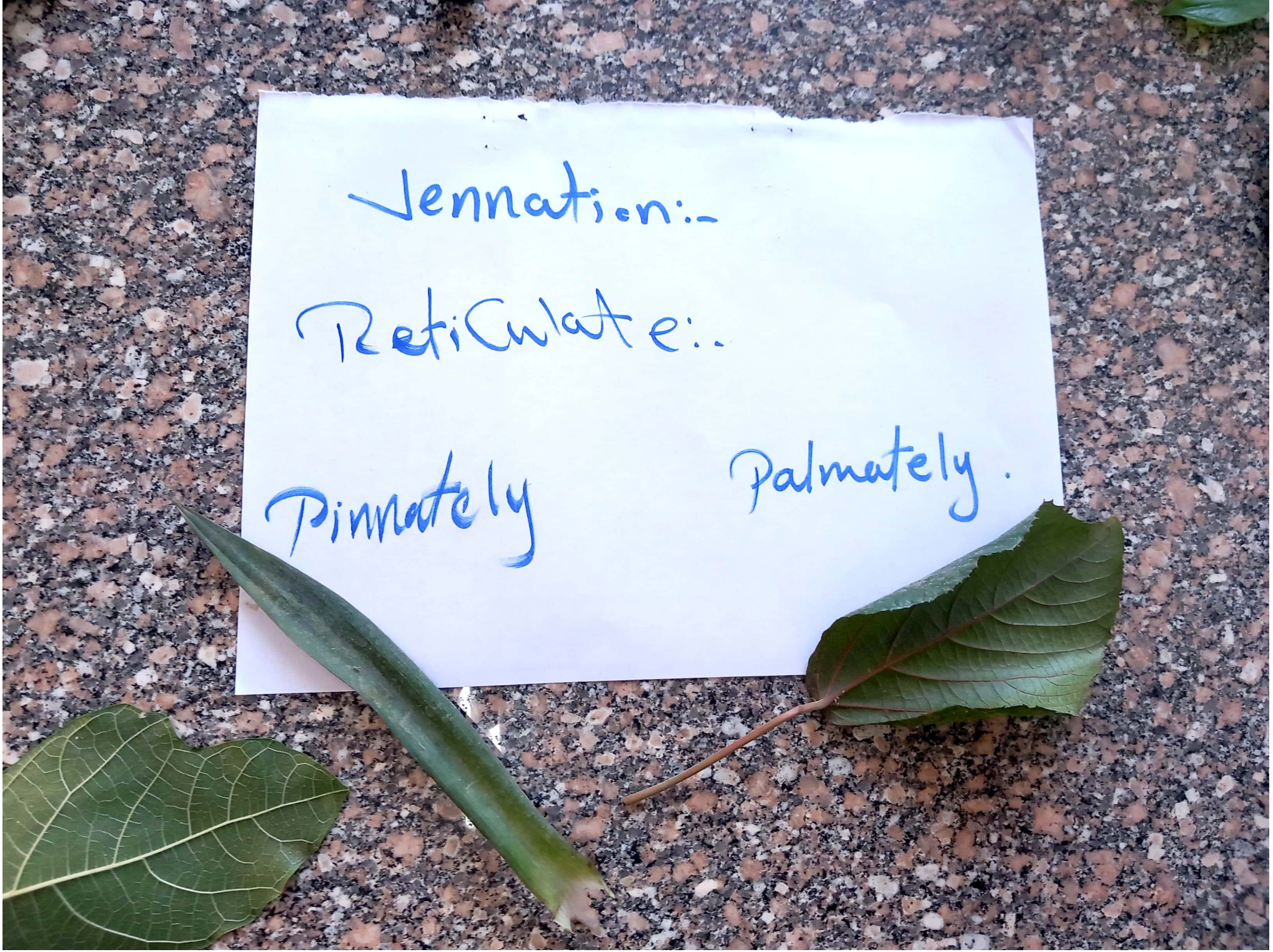
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