

~70 SPECIES

EARTH

3 GENERA

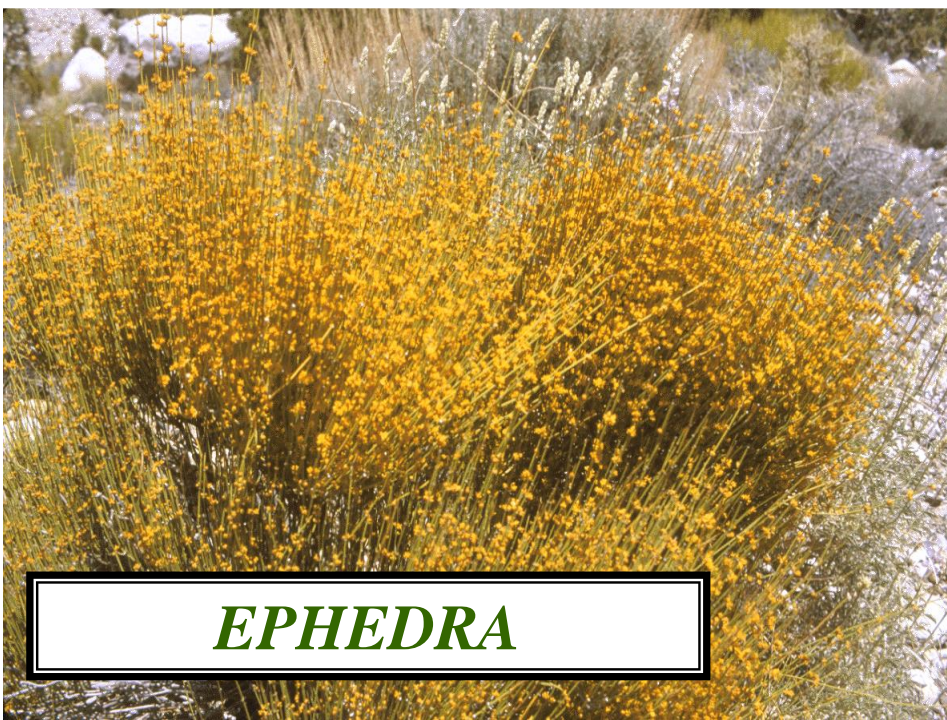
EARTH



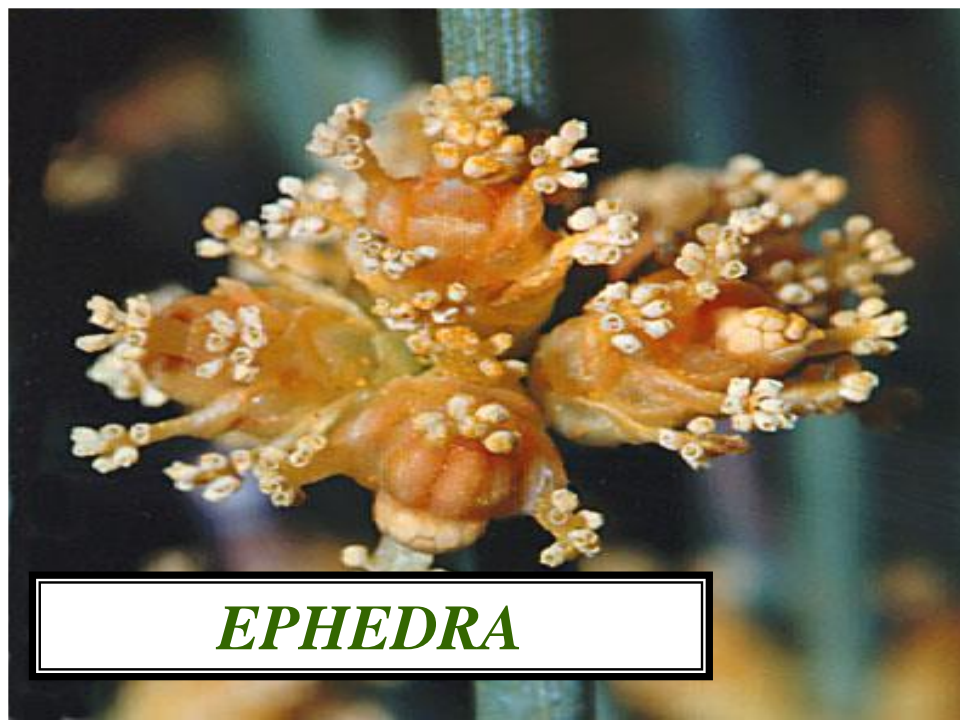
WELWITSCHIA



GNETUM



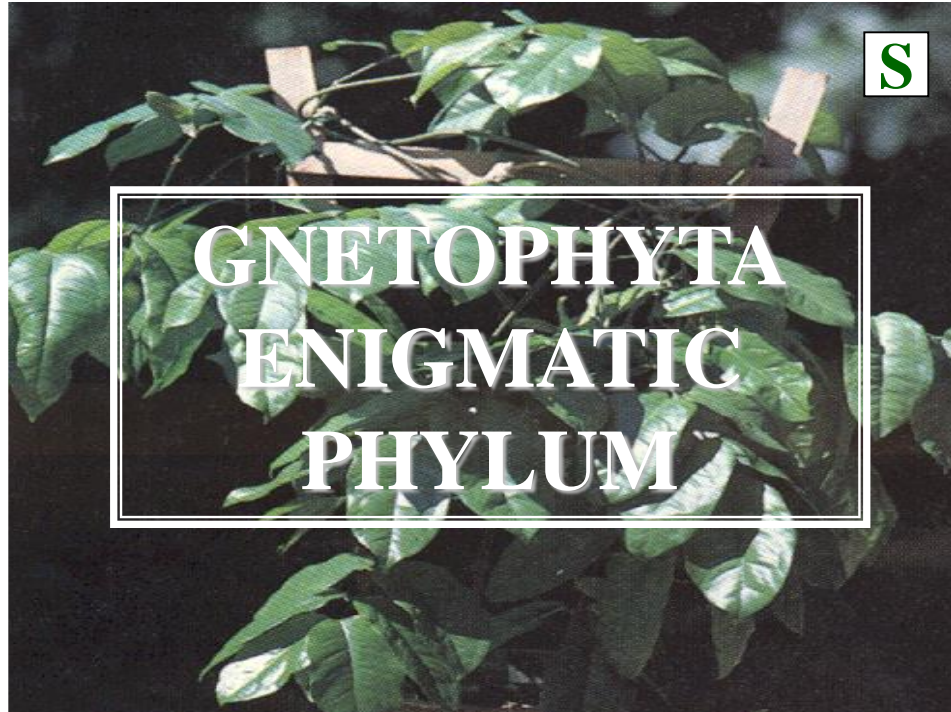
EPHEDRA



EPHEDRA



**GNETOPHYTA
ENIGMATIC
PHYLUM**



**GNETOPHYTA
ENIGMATIC
PHYLUM**



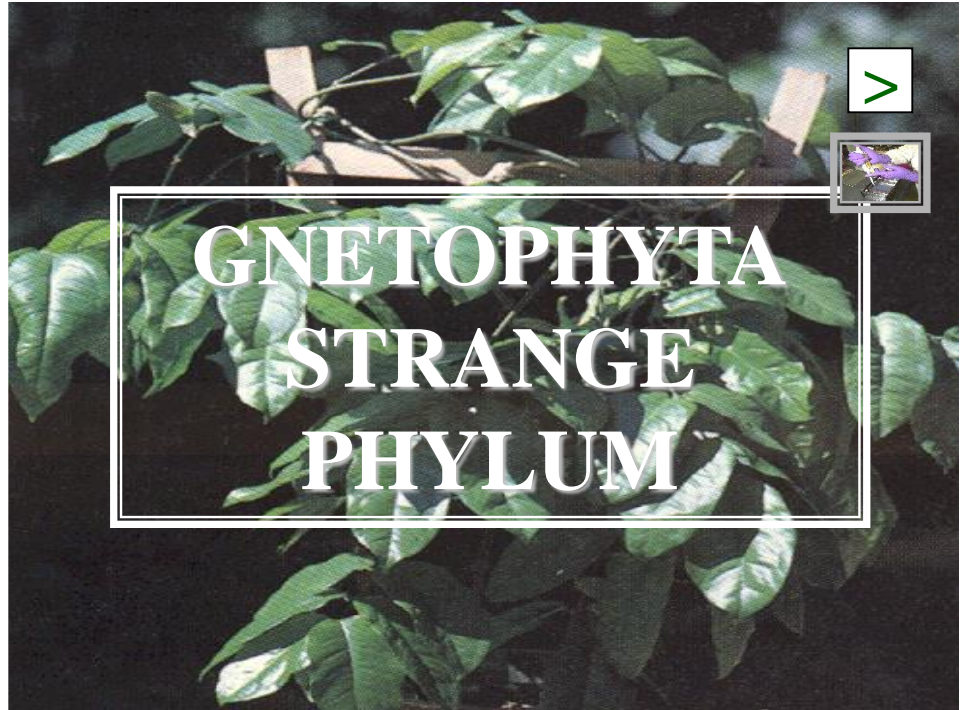
**GNETOPHYTA
ENIGMATIC
PHYLUM**



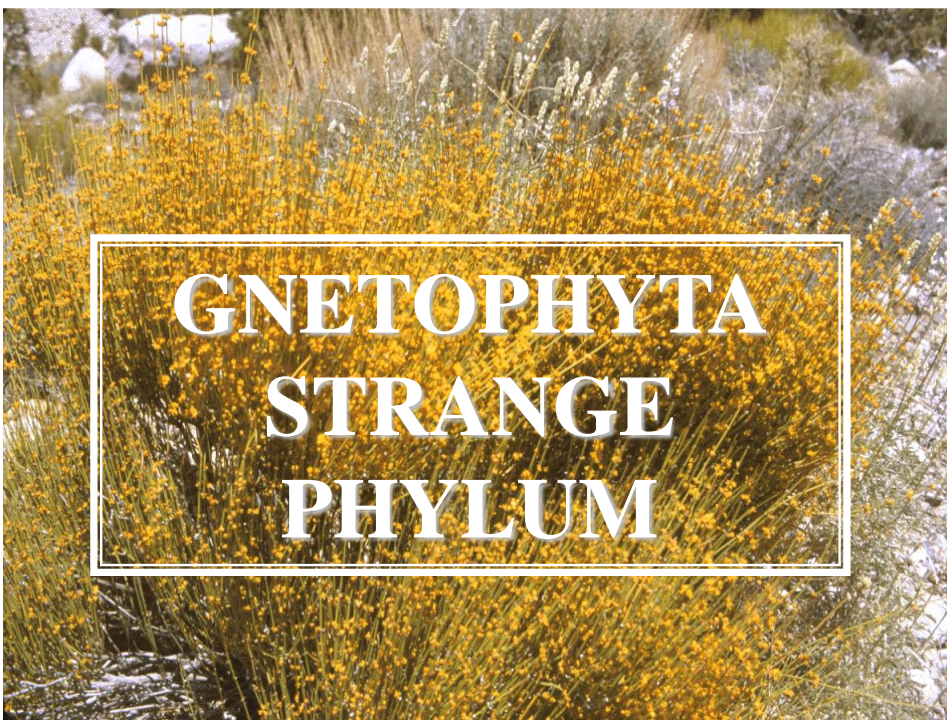
**GNETOPHYTA
ENIGMATIC
PHYLUM**



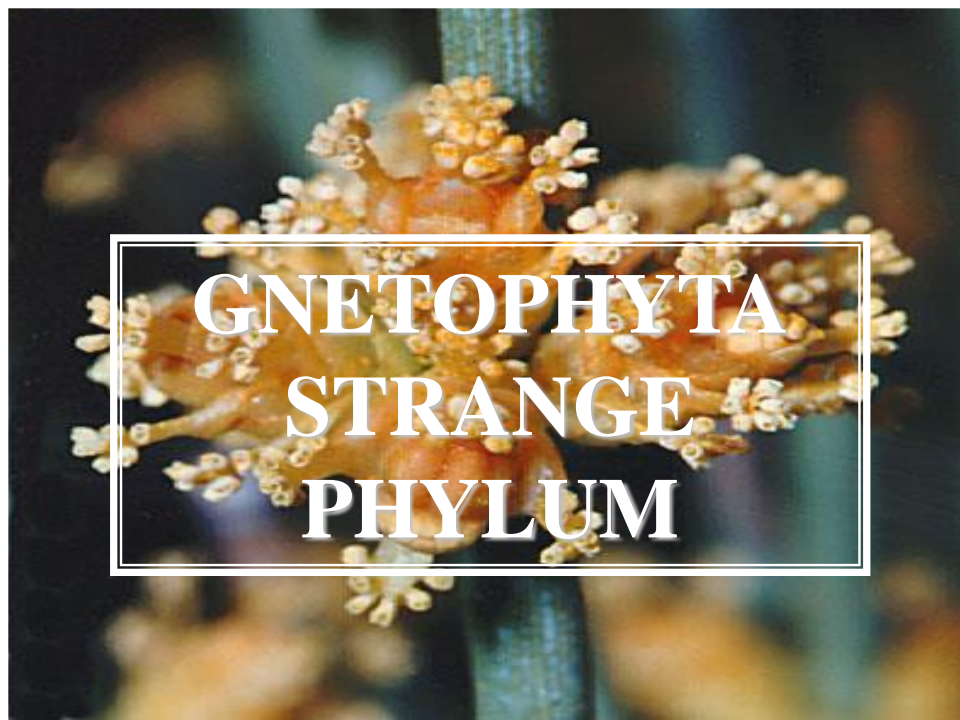
**GNETOPHYTA
STRANGE
PHYLUM**



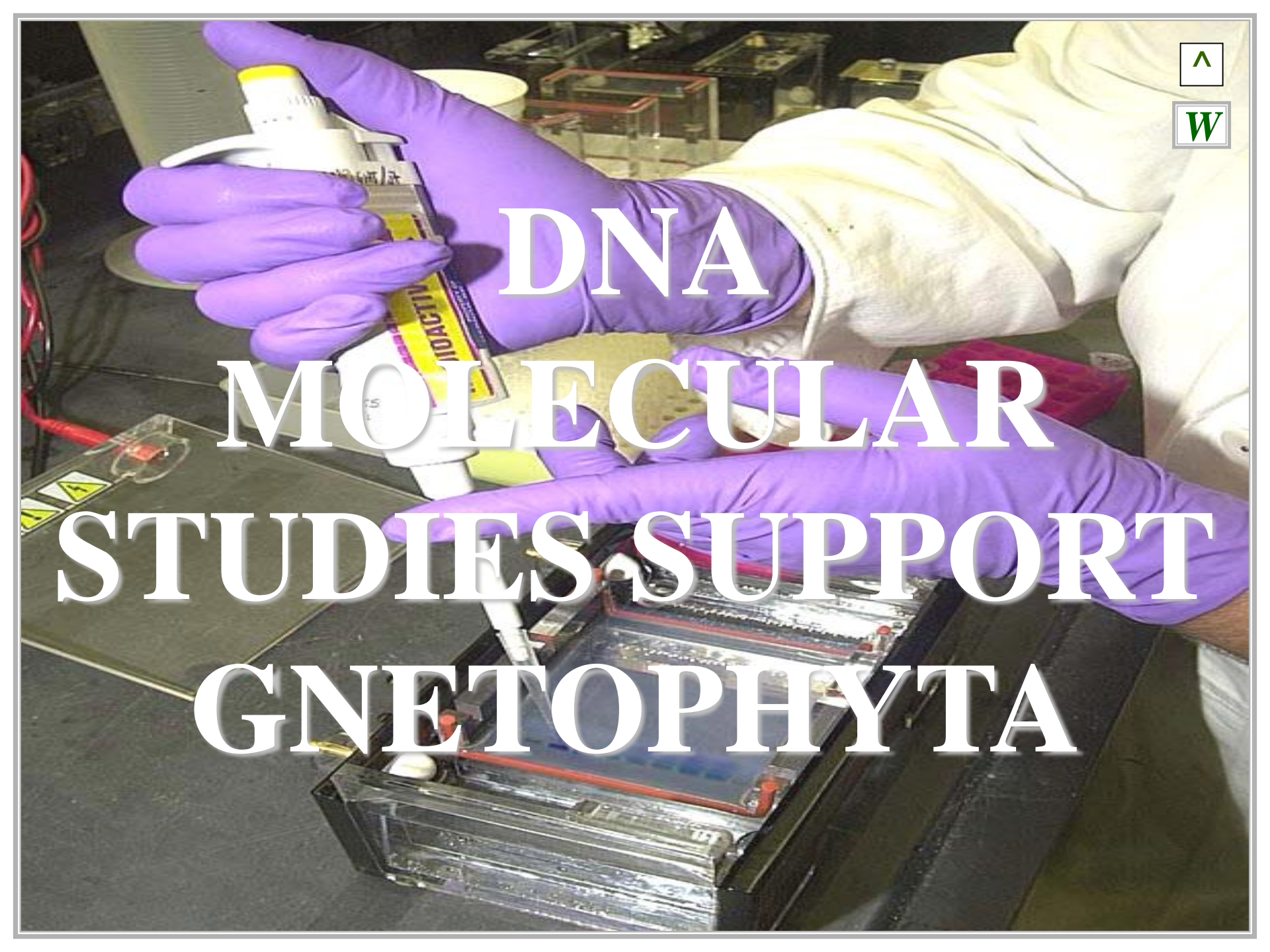
**GNETOPHYTA
STRANGE
PHYLUM**



**GNETOPHYTA
STRANGE
PHYLUM**



**GNETOPHYTA
STRANGE
PHYLUM**

A photograph of a person in a white lab coat and purple gloves using a pipette to transfer liquid into a multi-well plate. The person is holding the pipette with their right hand and the plate with their left hand. The background shows laboratory equipment and a power supply unit with a warning sign.

DNA MOLECULAR STUDIES SUPPORT GNETOPHYTA



WELWITSCHIA



WELWITSCHIA



DISTRIBUTION



AFRICA ENDEMIC

EARTH



**NAMIB
DESERT**



HABITAT

NAMIB DESERT





WELWITSCHIA

MORPHOLOGY



WELWITSCHIA



L



SUBTERRANEAN STEM





WELWITSCHIA



O



SUBTERRANEAN STEM

STRAP-LIKE LEAVES





WELWITSCHIA



SUBTERRANEAN STEM

OPPOSITE LEAVES

STRAP-LIKE LEAVES





WELWITSCHIA



“B

MICROSTROBILI FLOWER-LIKE



SUBTERRANEAN STEM

OPPOSITE LEAVES

STRAP-LIKE LEAVES



MEGASTROBILI



MOST “BIZARRE” TRACHEOPHYTE

WELWITSCHIA



EPHEDRA



EPHEDRA



DISTRIBUTION



TEMPERATE

EARTH



INDIGENOUS SOUTHWEST UNITED STATES



EPHEDRA



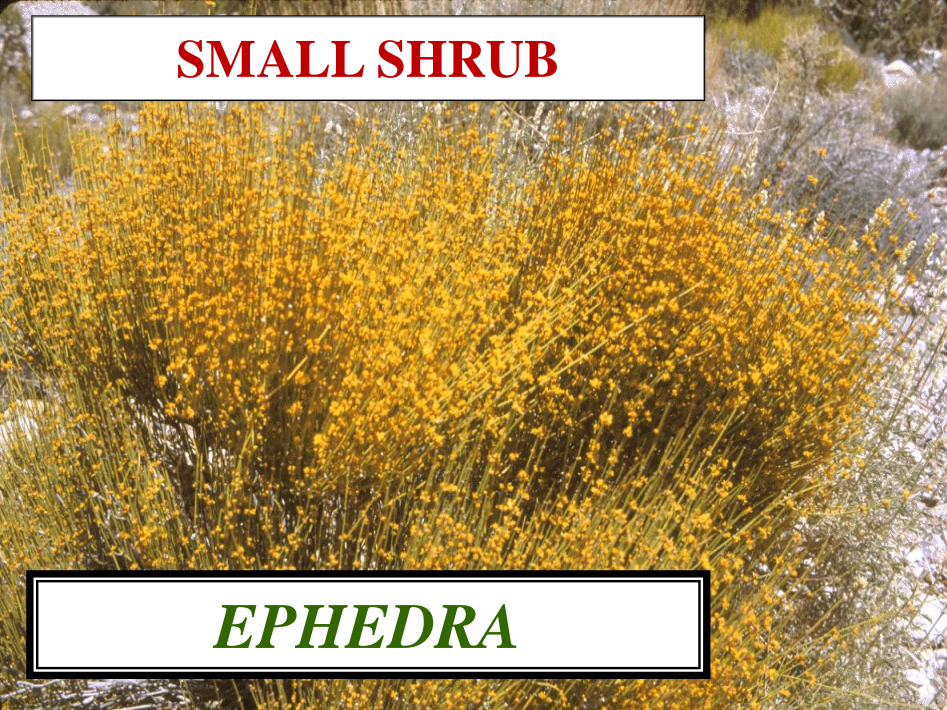
HABITAT

TEMPERATE DESERT



MORPHOLOGY

SMALL SHRUB

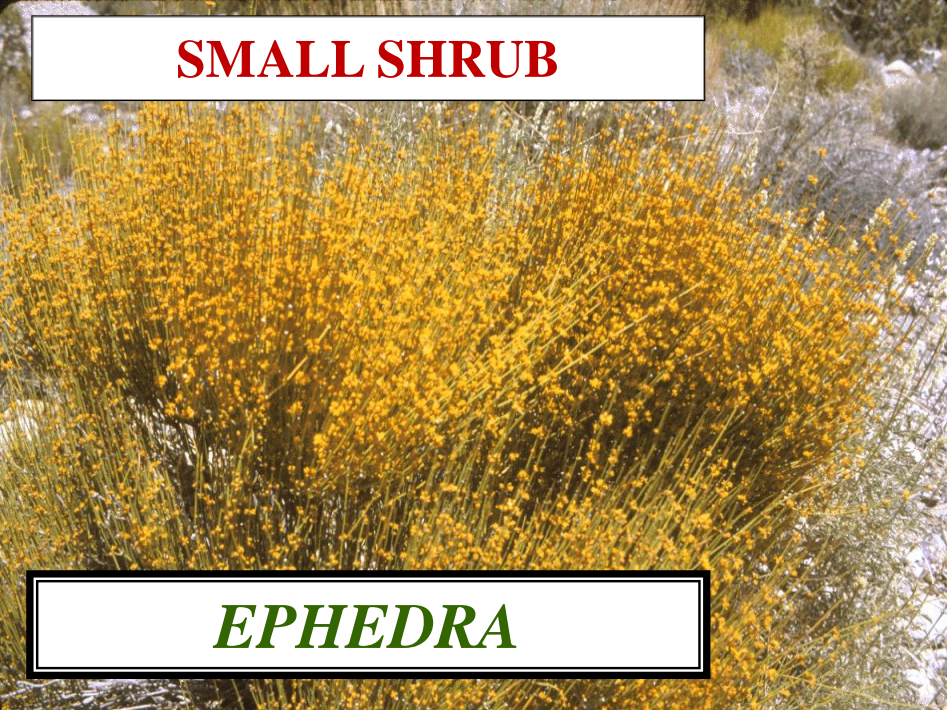


EPHEDRA

A



SMALL SHRUB



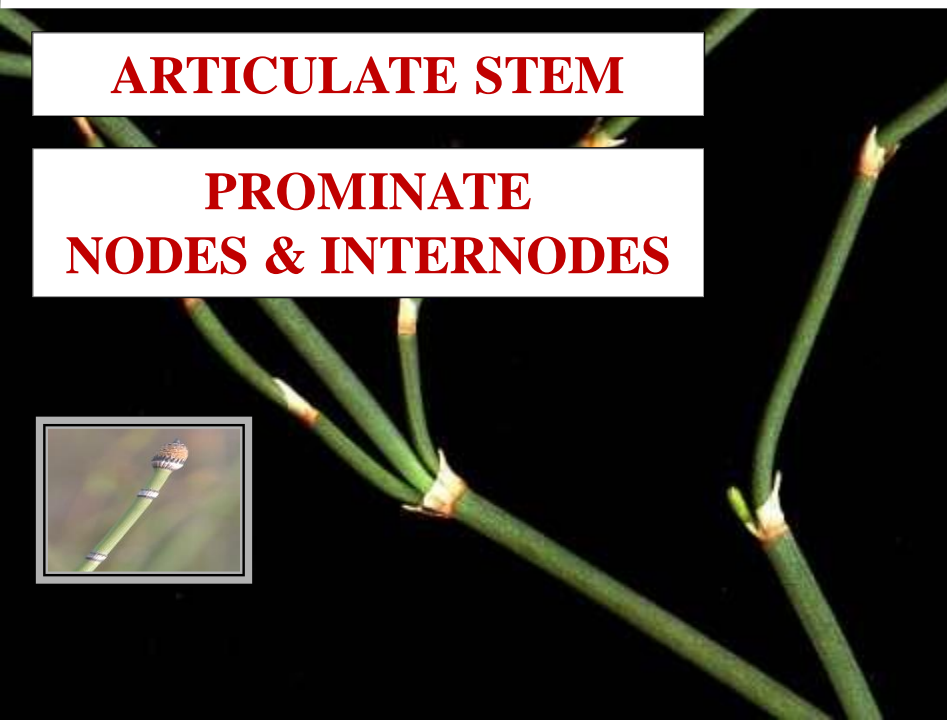
EPHEDRA

N

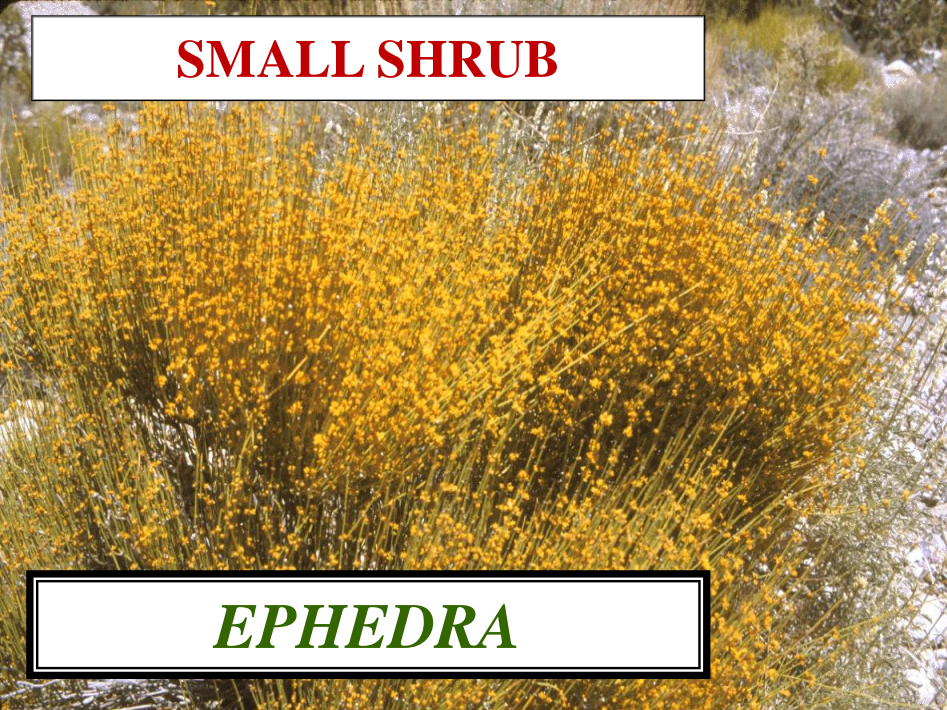


ARTICULATE STEM

**PROMINENT
NODES & INTERNODES**



SMALL SHRUB

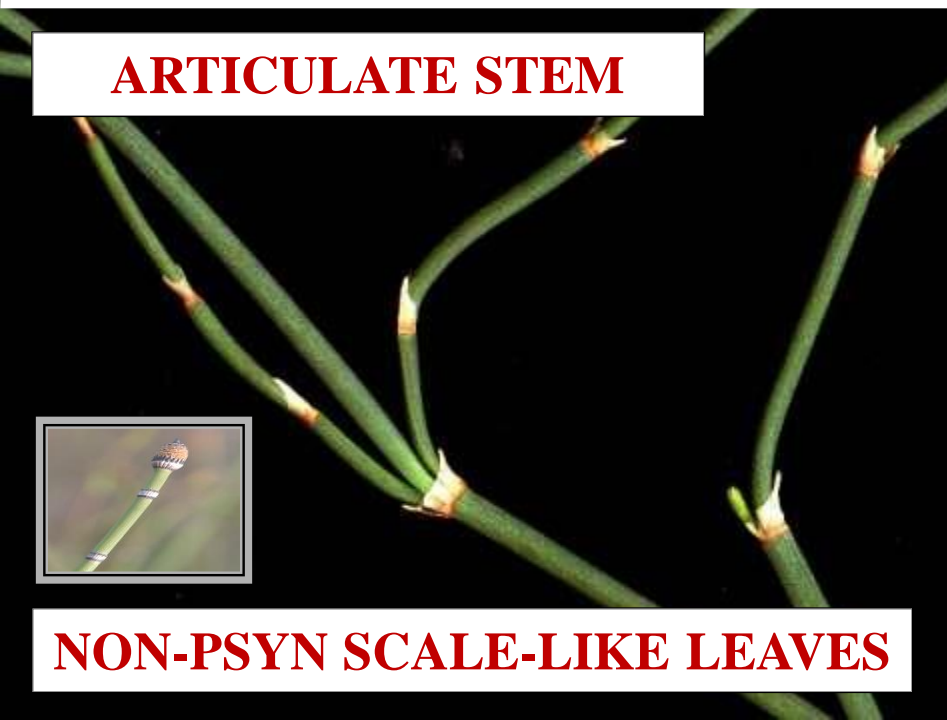


EPHEDRA

O



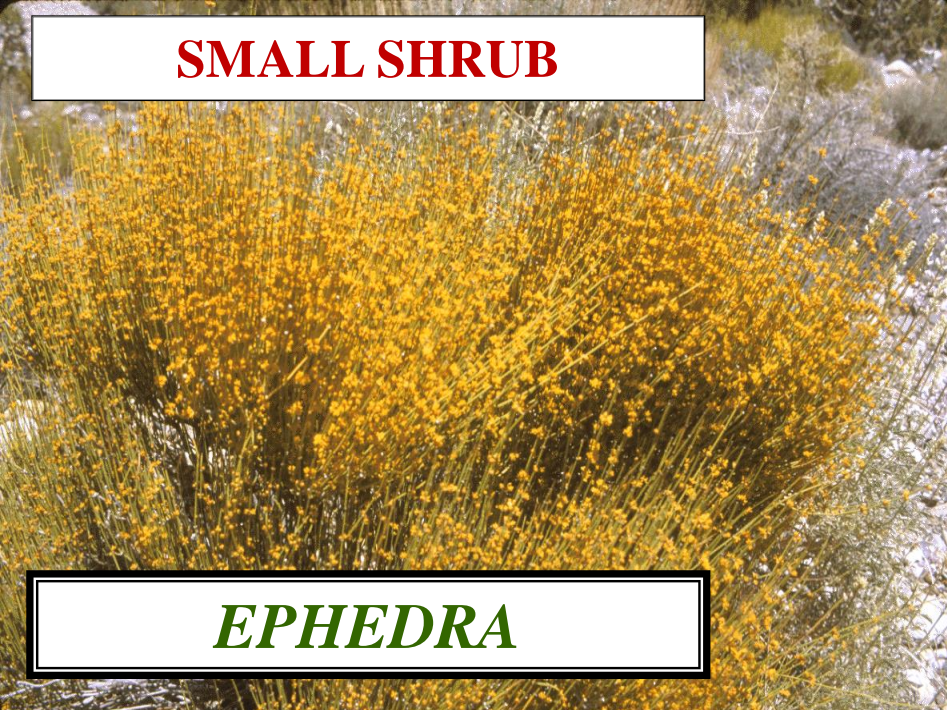
ARTICULATE STEM



NON-PSYN SCALE-LIKE LEAVES



SMALL SHRUB



EPHEDRA

ARTICULATE STEM

OPPOSITE LEAVES

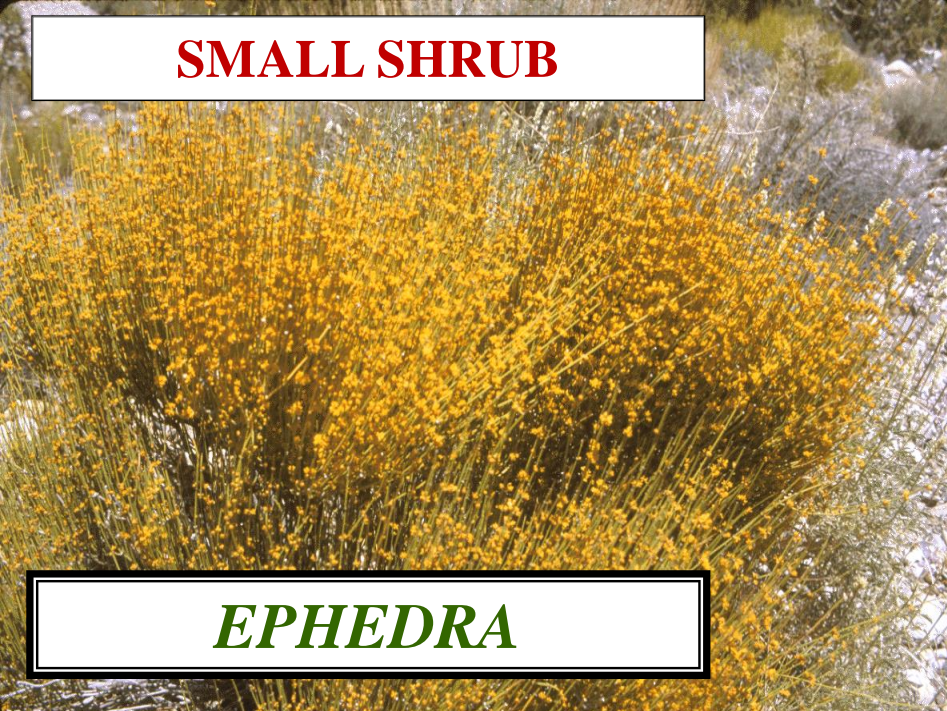


NON-PSYN SCALE-LIKE LEAVES

F



SMALL SHRUB



EPHEDRA

PD

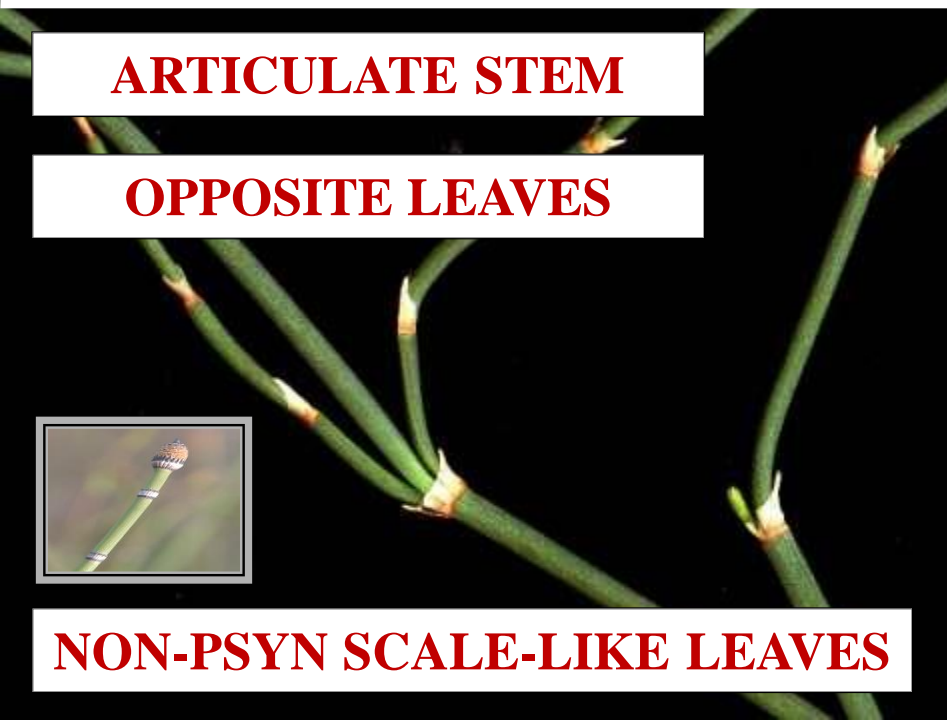


MICROSTROBILI FLOWER-LIKE



ARTICULATE STEM

OPPOSITE LEAVES

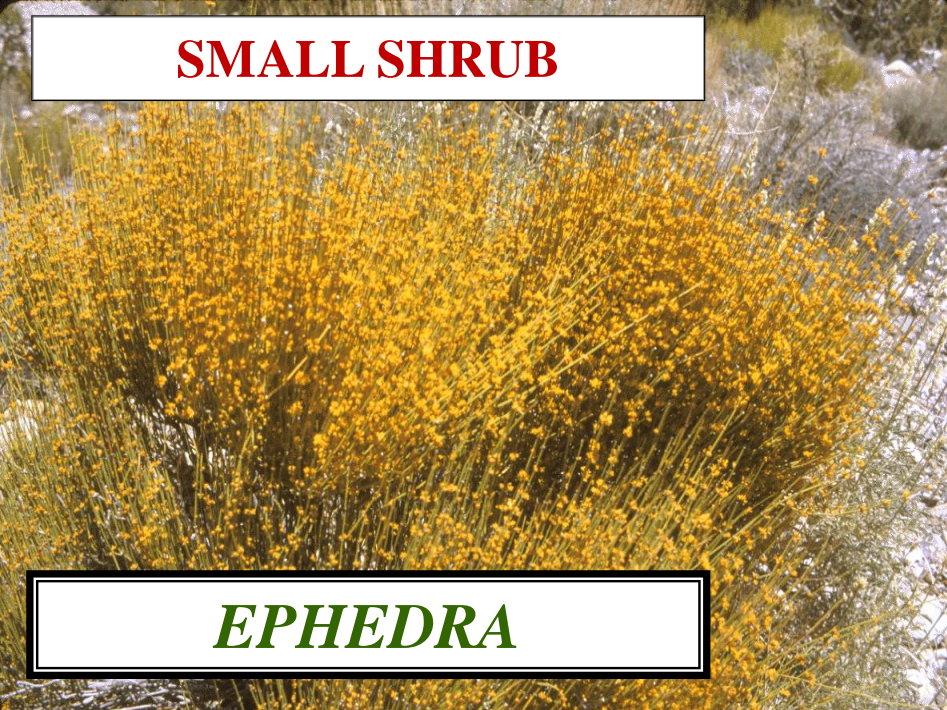


NON-PSYN SCALE-LIKE LEAVES



MEGASTROBILI

SMALL SHRUB



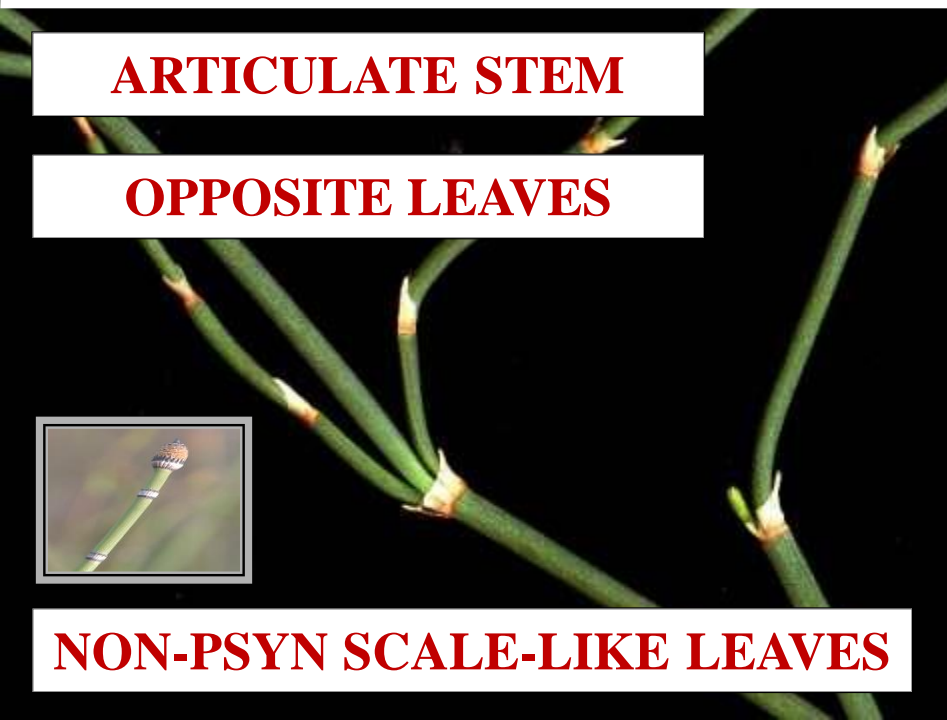
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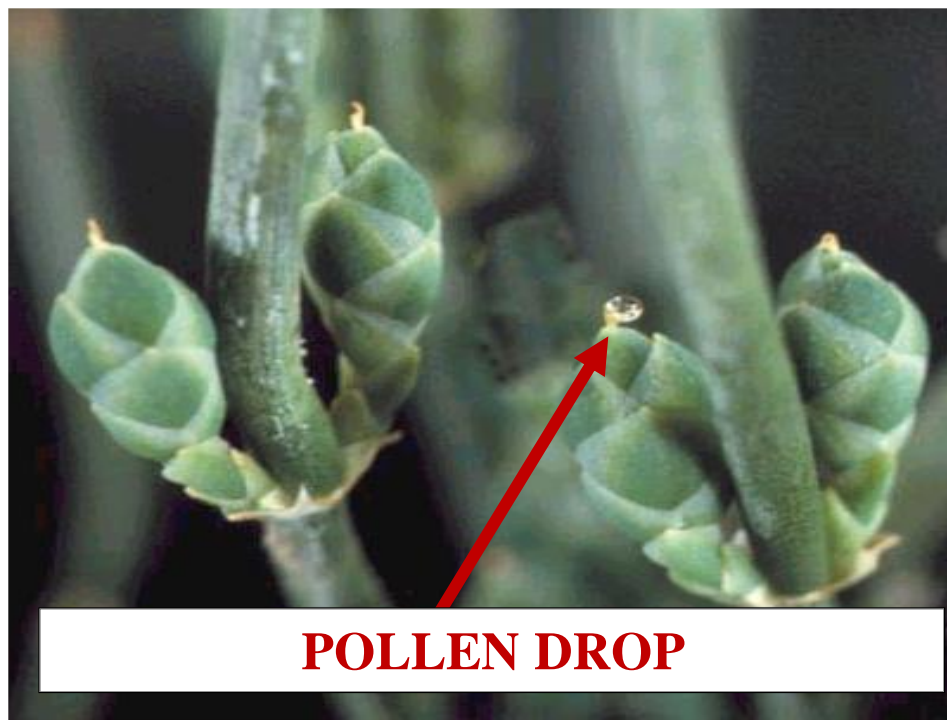
MICROSTROBILI FLOWER-LIKE

ARTICULATE STEM

OPPOSITE LEAVES



NON-PSYN SCALE-LIKE LEAVES



POLLEN DROP



GNETUM



GNETUM



DISTRIBUTION



TROPICAL

EARTH



HABITAT

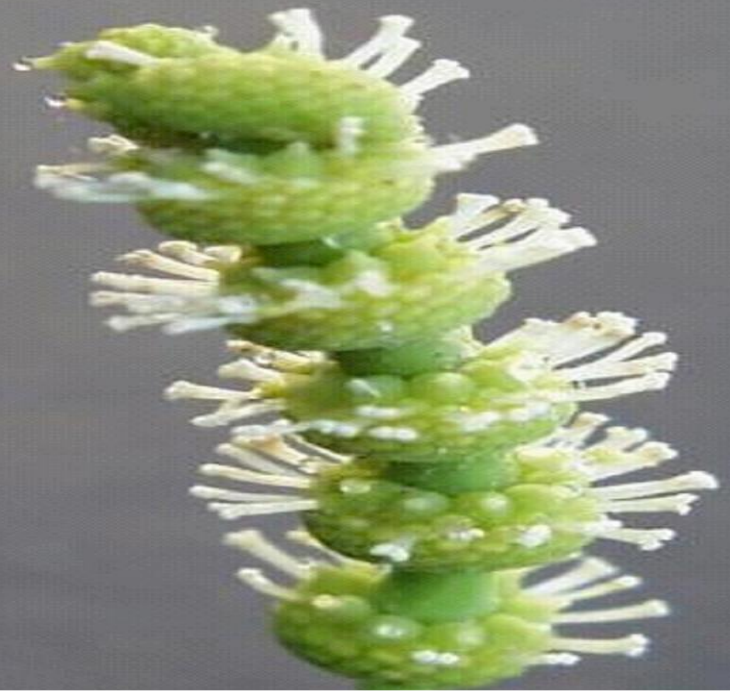


TROPICAL RAINFOREST

MORPHOLOGY

GNETUM

VINE



A



GNETUM

VINE



O



ANGIOSPERM-LIKE LEAVES



GNETUM

VINE

F

OPPOSITE LEAVES

ANGIOSPERM-LIKE LEAVES



GNETUM

VINE



+

“B”

MICROSTROBILI FLOWER-LIKE

OPPOSITE LEAVES

ANGIOSPERM-LIKE LEAVES



MEGASTROBILI

GNETUM

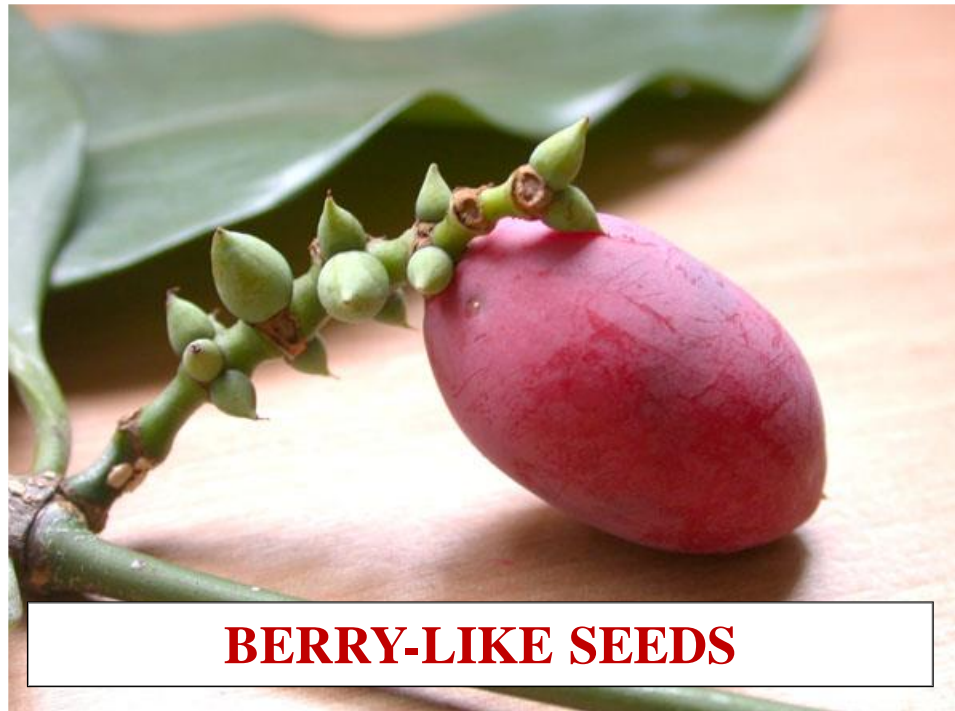
VINE



MICROSTROBILI FLOWER-LIKE

OPPOSITE LEAVES

ANGIOSPERM-LIKE LEAVES



BERRY-LIKE SEEDS



FOSSIL RECORD

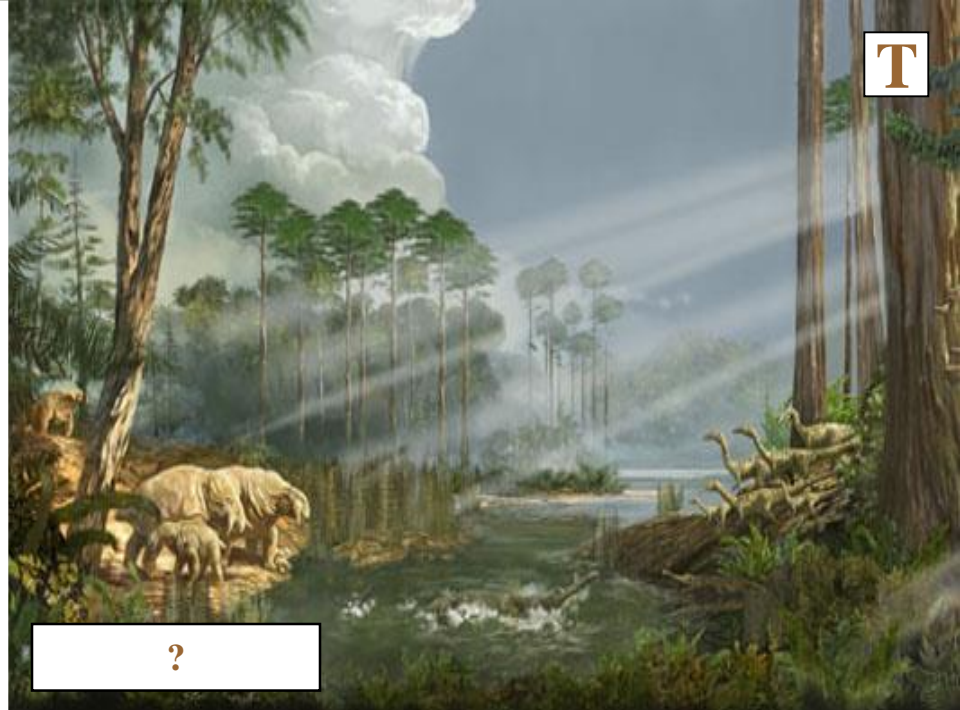


~200

MILLION YEARS



PERMIAN



T

?



JURASSIC



CRETACEOUS



PERMIAN



TRIASSIC



JURASSIC



CRETACEOUS



PERMIAN



P

**GNETOPHYTA
EVOLVE**

TRIASSIC



JURASSIC



CRETACEOUS

PALYNOLOGY

GNETOPHYTA PALYNOLOGY

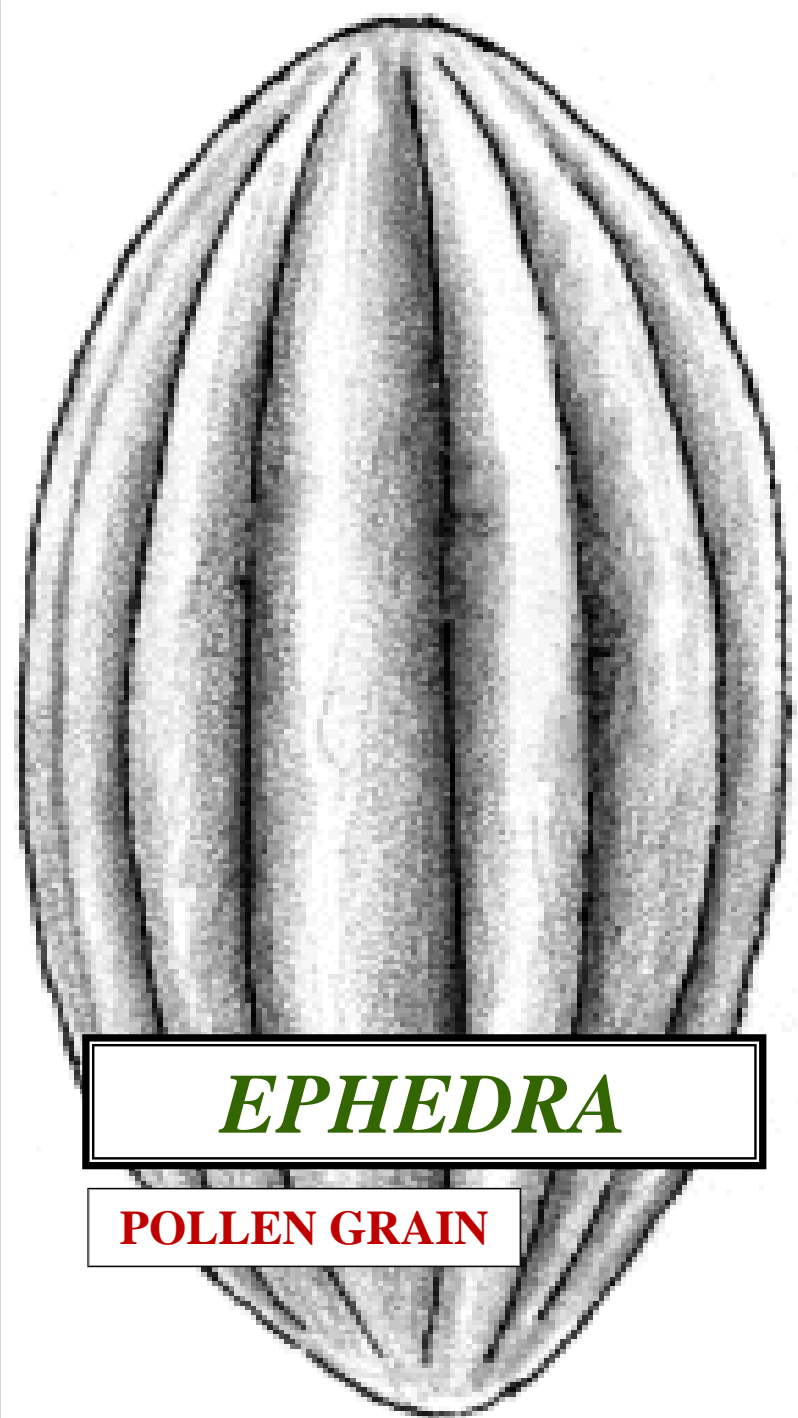


STUDY FOSSIL POLLEN

GNETOPHYTA PALYNOLOGY



POLLEN GRAIN



EPHEDRA

POLLEN GRAIN





~120

MILLION YEARS



PERMIAN



TRIASSIC

C



JURASSIC



?



PERMIAN



TRIASSIC



JURASSIC



CRETACEOUS



PERMIAN



TRIASSIC



JURASSIC

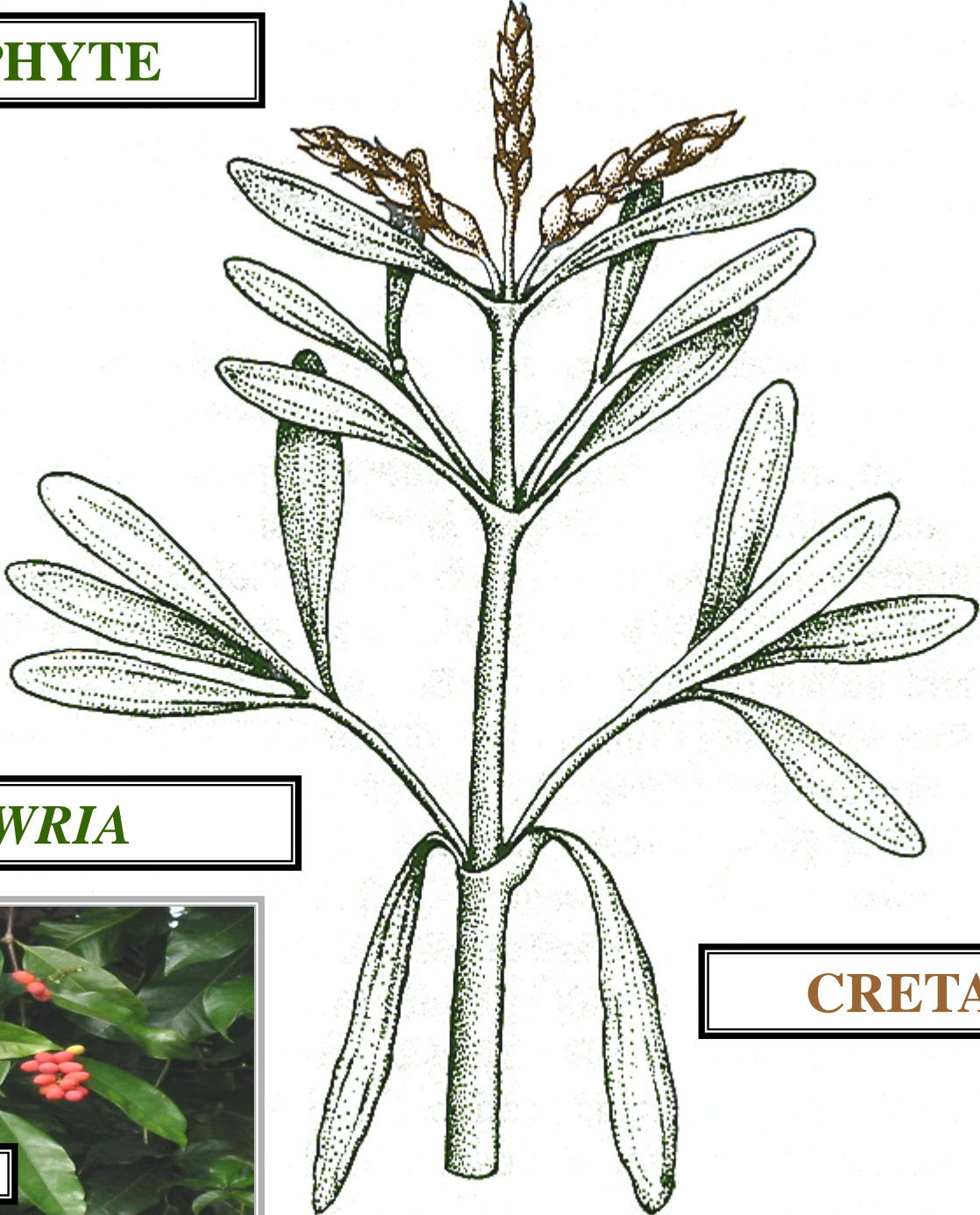


GNETOPHYTA
ZENITH

CRETACEOUS



GNETOPHYTE



DREWRIA



GNETUM

CRETACEOUS

PHYLOGENETIC RELATIONSHIP

PTERIDOSPERMOPHYTA

MANOXYLIC WOOD

CYCADOPHYTA

PYCNOXYLIC WOOD

**FLAGELLATED
SPERM**

GINKGOPHYTA

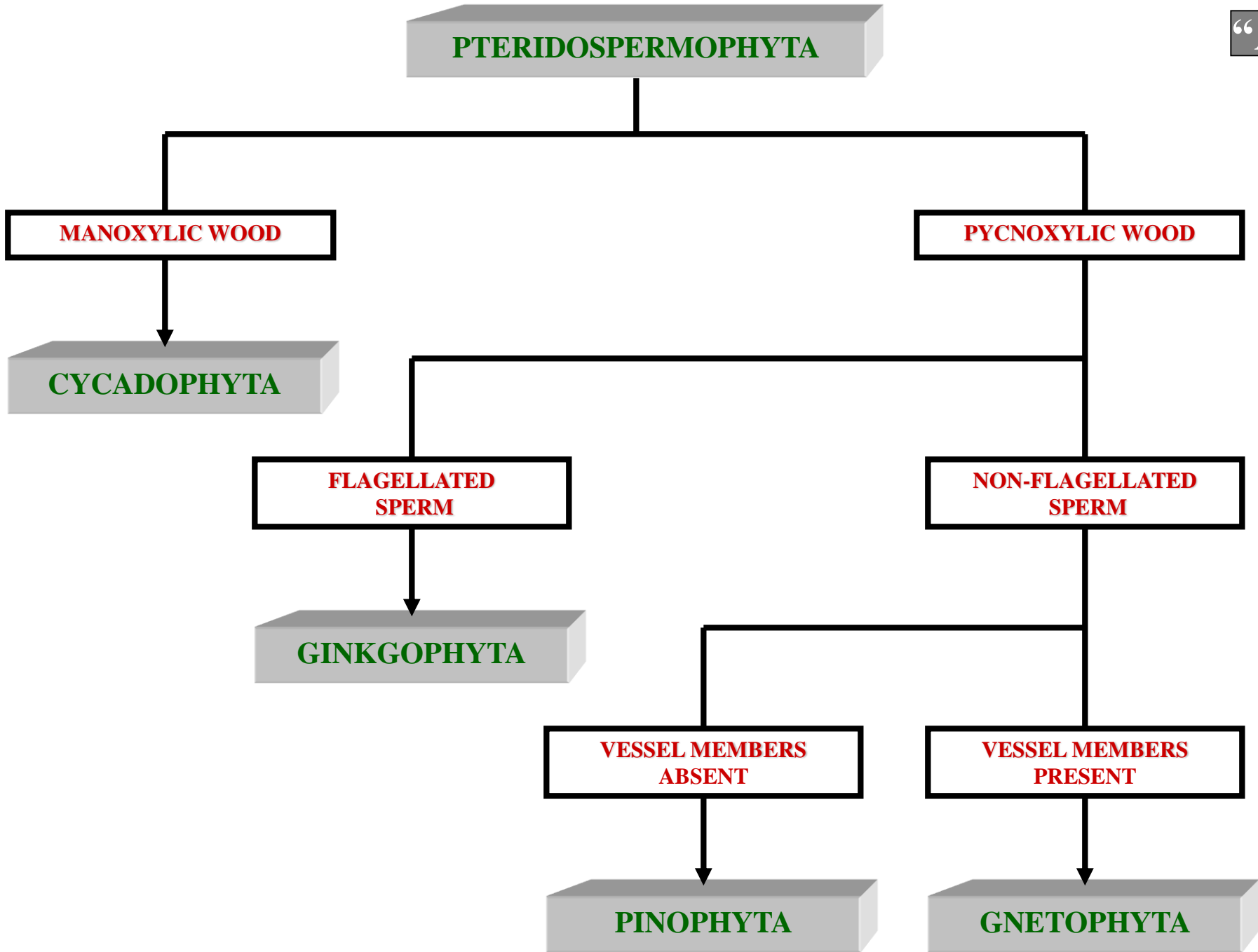
**NON-FLAGELLATED
SPERM**

**VESSEL MEMBERS
ABSENT**

PINOPHYTA

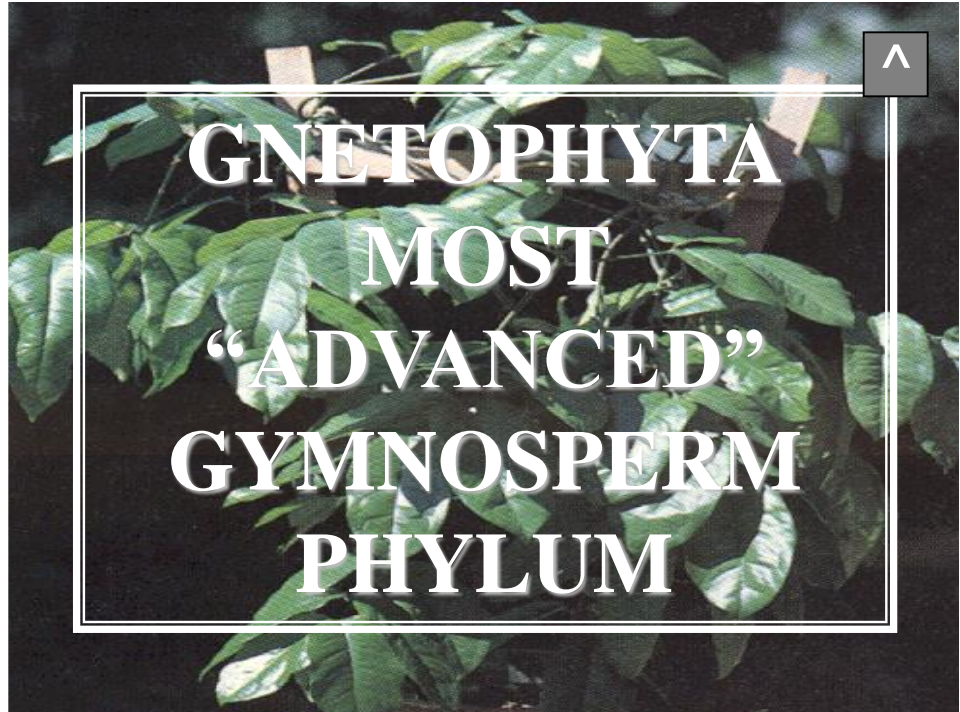
**VESSEL MEMBERS
PRESENT**

GNETOPHYTA

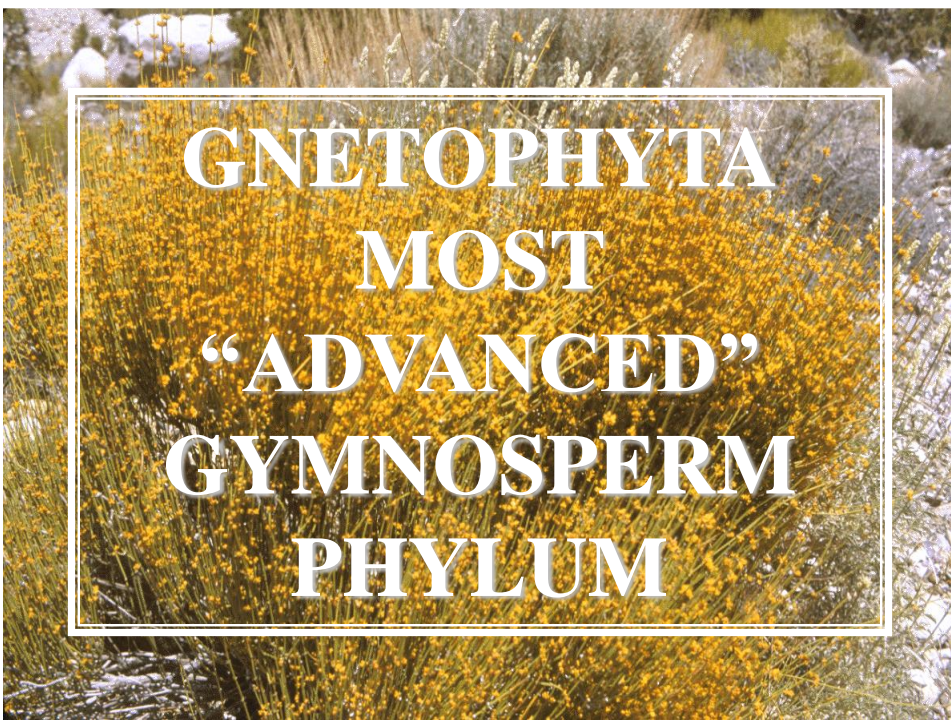




**GNETOPHYTA
MOST
“ADVANCED”
GYMNOSPERM
PHYLUM**



**GNETOPHYTA
MOST
“ADVANCED”
GYMNOSPERM
PHYLUM**



**GNETOPHYTA
MOST
“ADVANCED”
GYMNOSPERM
PHYLUM**



**GNETOPHYTA
MOST
“ADVANCED”
GYMNOSPERM
PHYLUM**

SHARED ANGIOSPERM CHARACTERS



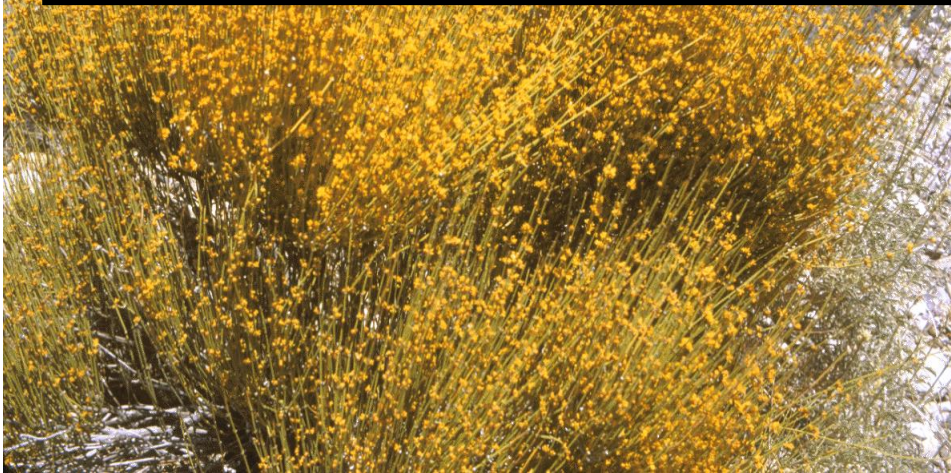
VESSEL MEMBERS





A

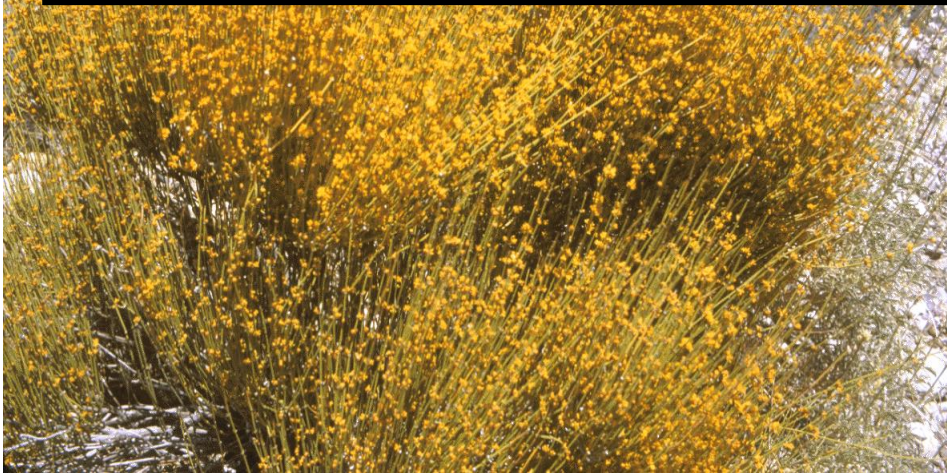
FLOWER-LIKE MICROSTROBILI





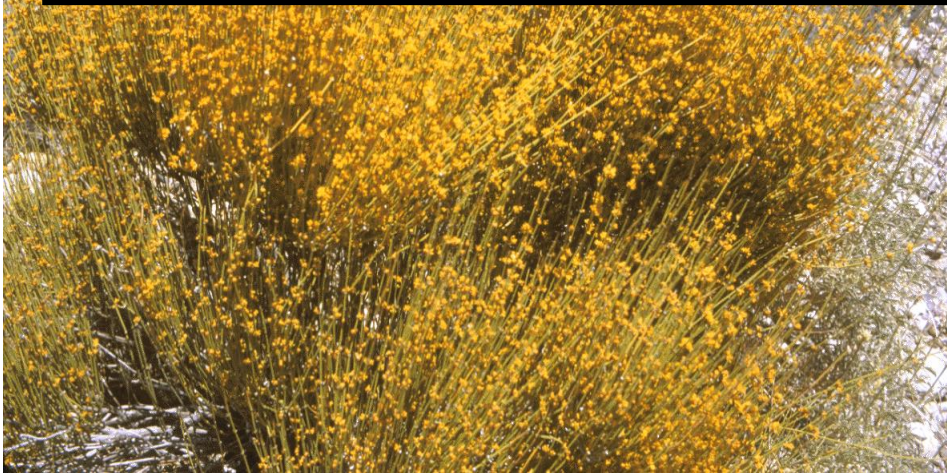
D

ARCHEGONIA ABSENT





DOUBLE FERTILIZATION



QUESTION
GNETOPHYTES
RELATED
TO
ANGIOSPERMS?
QUESTION

ANSWER

**NO DIRECT
RELATIONSHIP
TO**

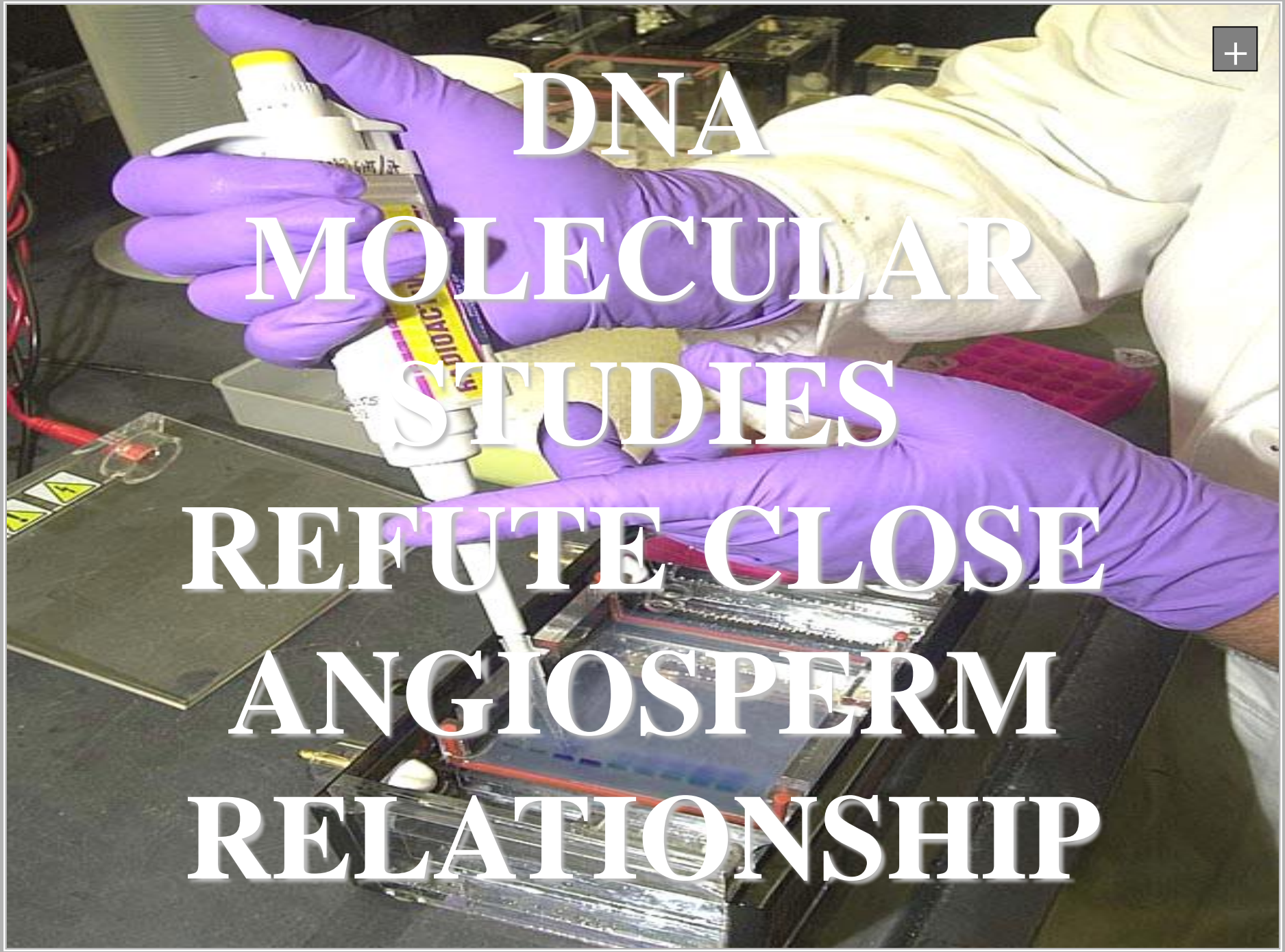
ANGIOSPERMS

ANSWER



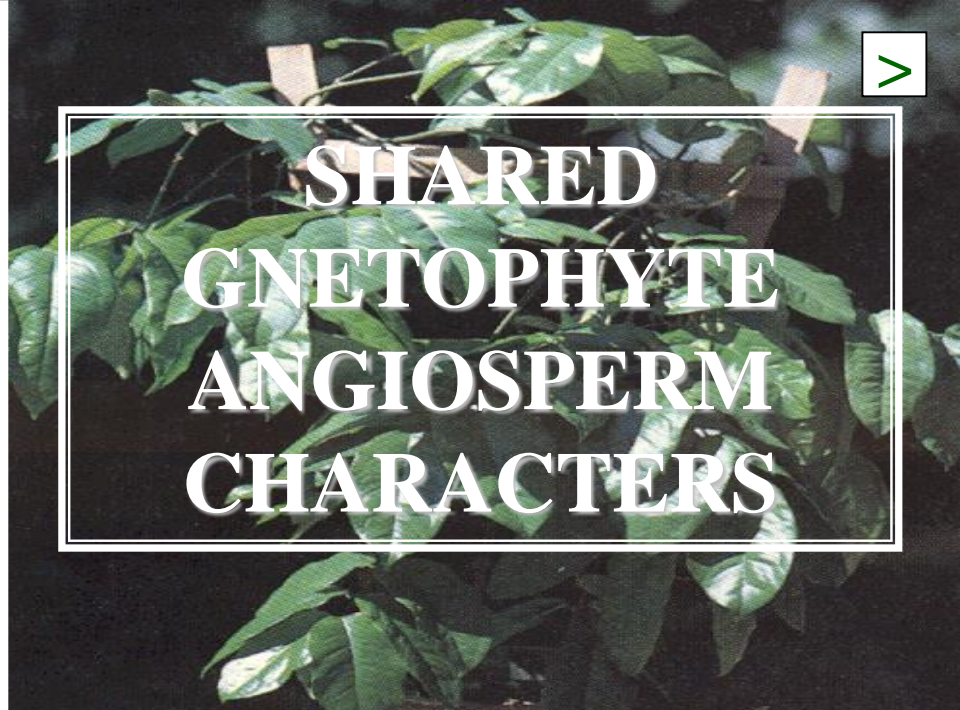


DNA
MOLECULAR
STUDIES
REFUTE CLOSE
ANGIOSPERM
RELATIONSHIP

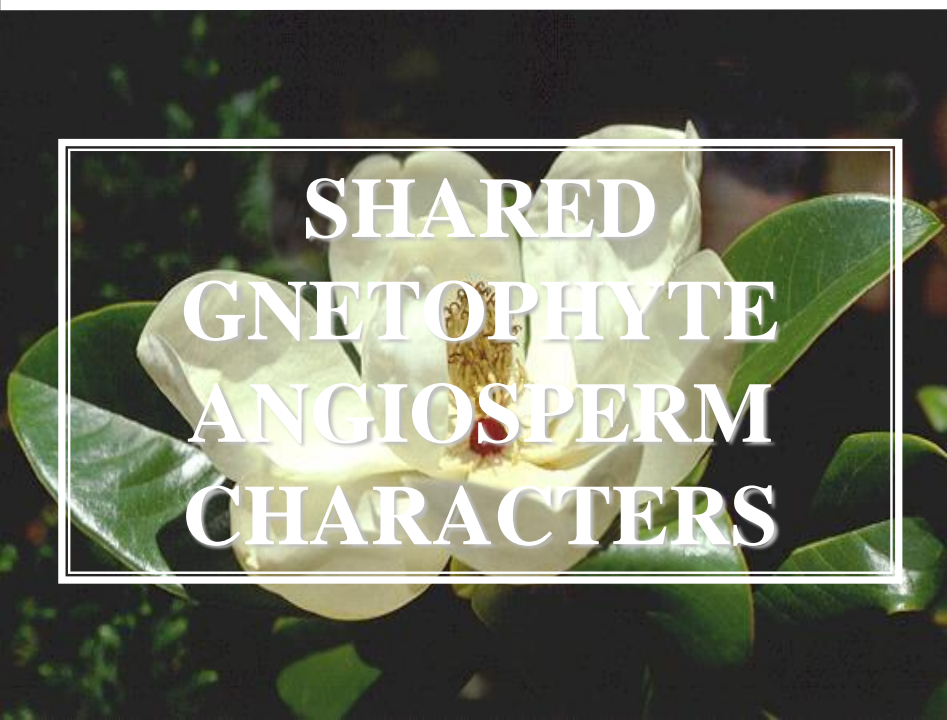




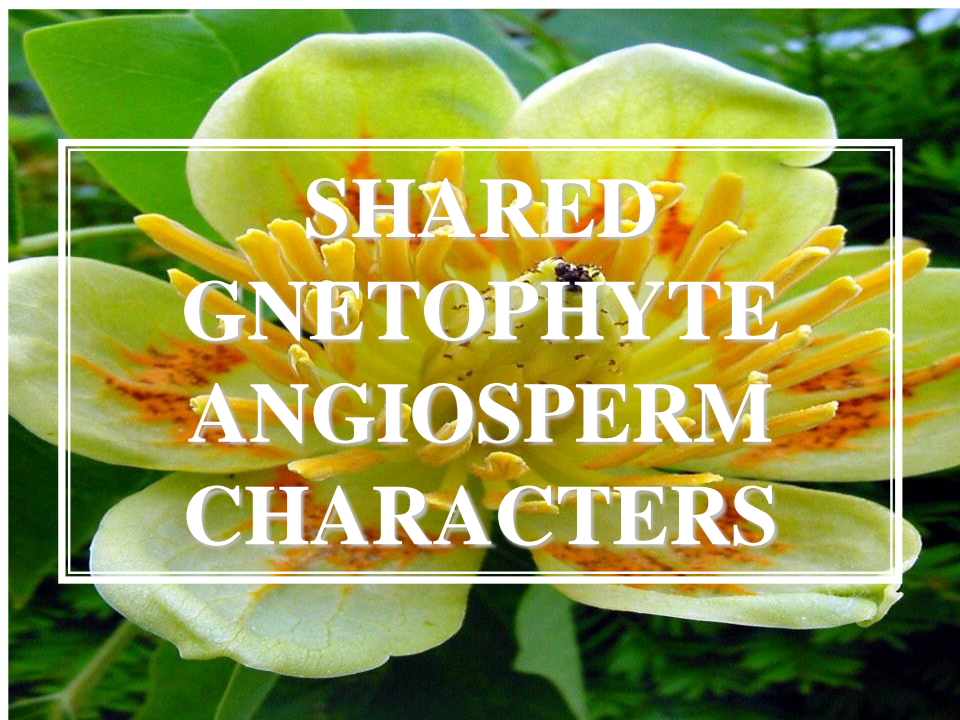
SHARED
GNETOPHYTE
ANGIOSPERM
CHARACTERS



SHARED
GNETOPHYTE
ANGIOSPERM
CHARACTERS



SHARED
GNETOPHYTE
ANGIOSPERM
CHARACTERS



SHARED
GNETOPHYTE
ANGIOSPERM
CHARACTERS





SHARED
GNETOPHYTE
ANGIOSPERM
CHARACTERS
CONVERGENT
EVOLUTION



SHARED
GNETOPHYTE
ANGIOSPERM
CHARACTERS
CONVERGENT
EVOLUTION



SHARED
GNETOPHYTE
ANGIOSPERM
CHARACTERS
CONVERGENT
EVOLUTION



SHARED
GNETOPHYTE
ANGIOSPERM
CHARACTERS
CONVERGENT
EVOLUTION

PTERIDOSPERMOPHYTA

MANOXYLIC WOOD

CYCADOPHYTA

PYCNOXYLIC WOOD

**FLAGELLATED
SPERM**

GINKGOPHYTA

**NON-FLAGELLATED
SPERM**

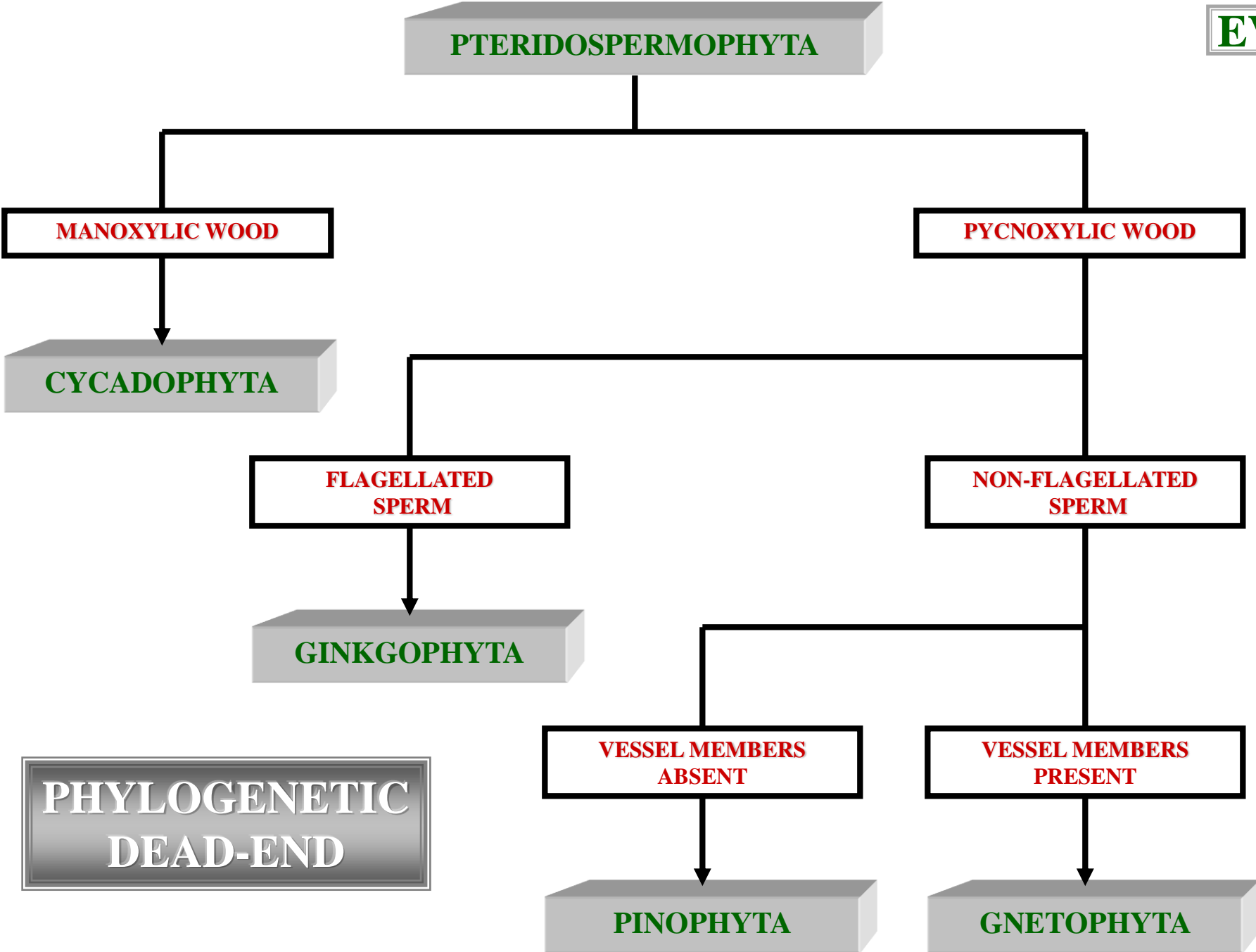
**VESSEL MEMBERS
ABSENT**

PINOPHYTA

**VESSEL MEMBERS
PRESENT**

GNETOPHYTA

**PHYLOGENETIC
DEAD-END**





VASCULAR PLANT EVOLUTION



**~130
MILLION YEARS**



ANGIOSPERMS EVOLVE



ANGIOSPERMS

ANGIO

**ANGIOSPERM
SPERM**

ENCLOSED

**ANGIOSPERM
SPERM**

SPERM

ANGIOSPERM SPERM



OVULE / SEED

ANGIOSPERM SPERM

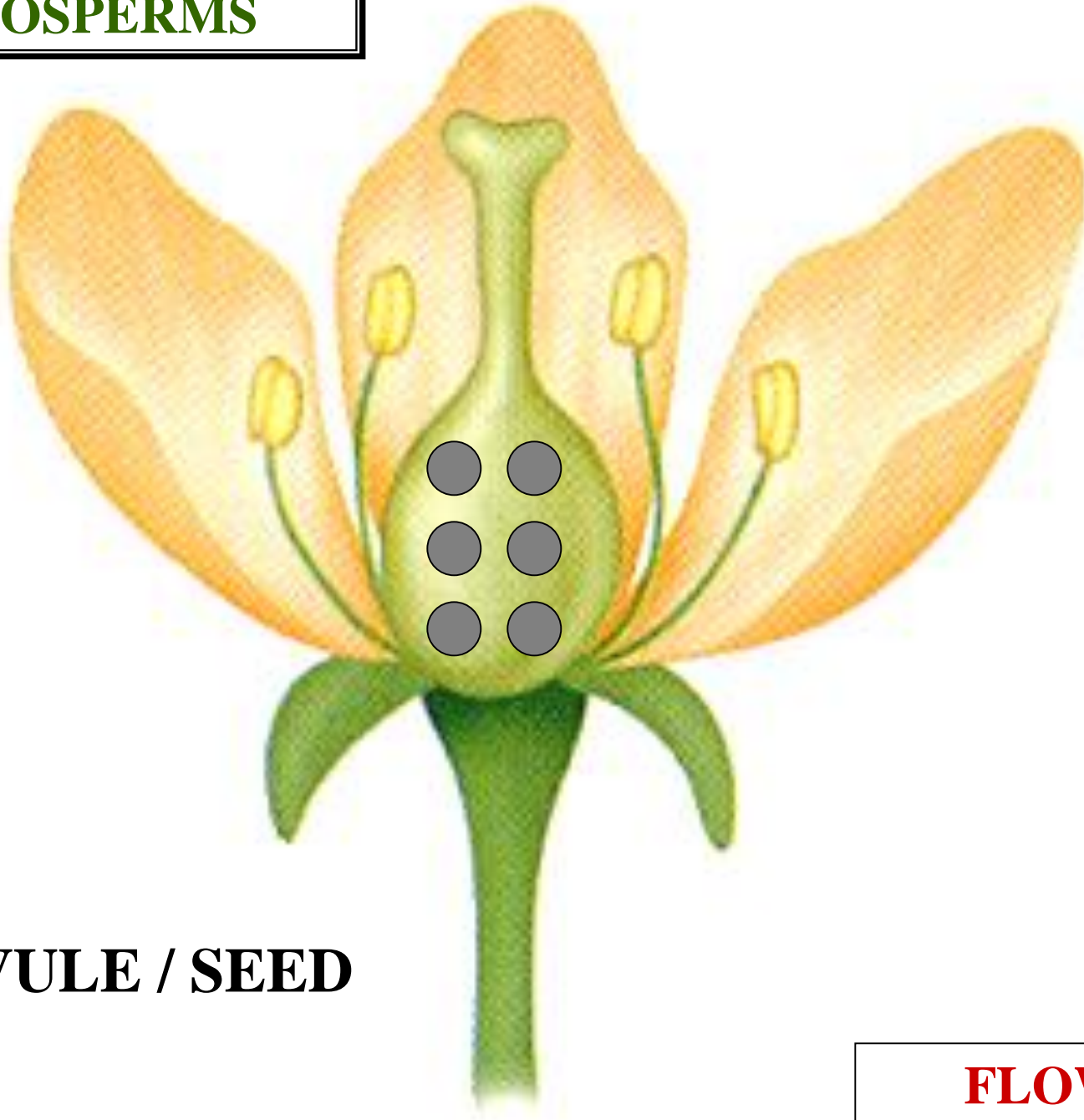
ANGIOSPERMS



FLOWER

ANGIOSPERMS

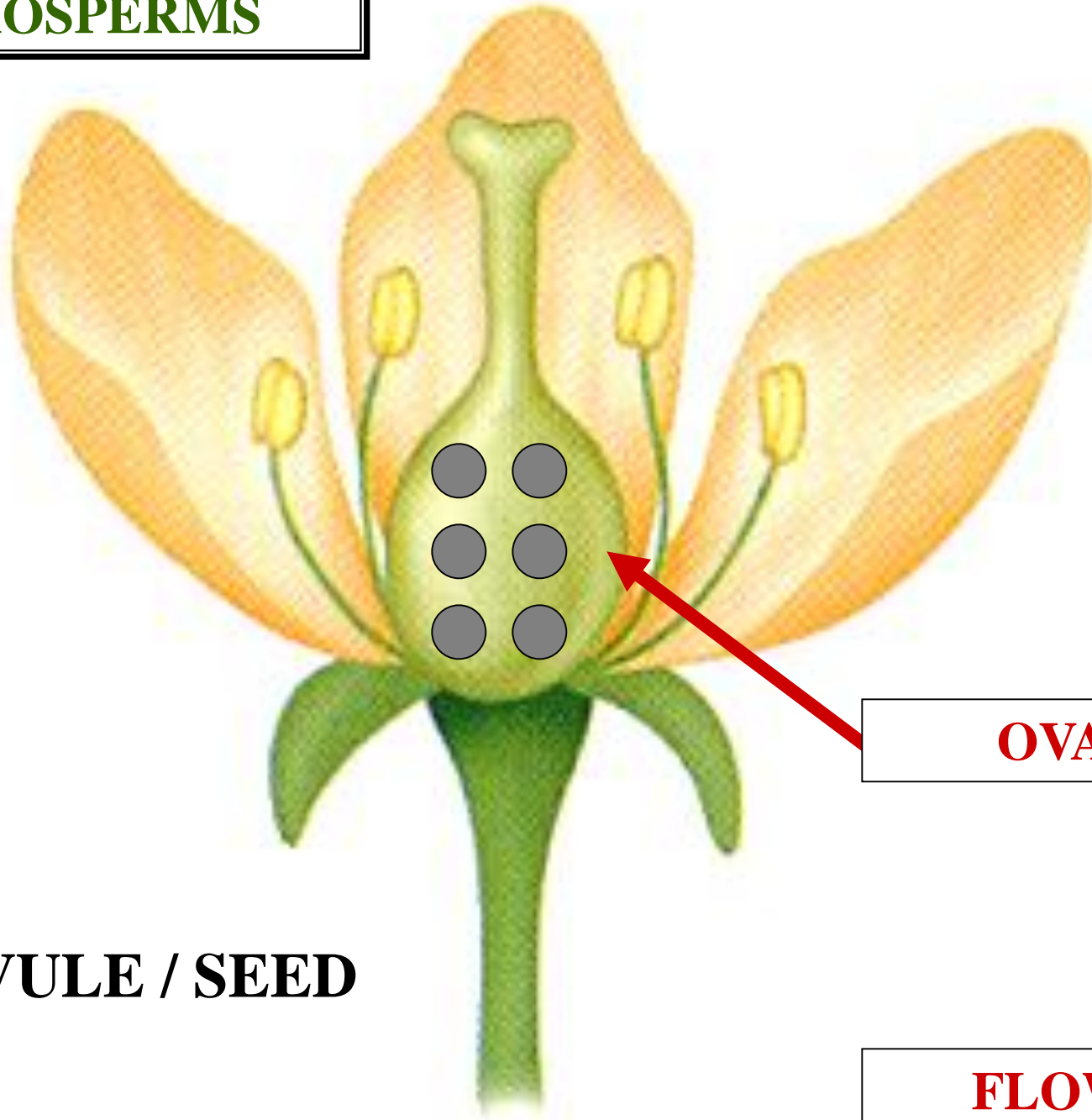
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● = OVULE / SEED

FLOWER

ANGIOSPERMS




● = OVULE / SEED

OVARY

FLOWER



**ANGIOSPERM
OVULE / SEED
ENCLOSED
WITHIN
OVARY**



**ANGIOSPERM
OVULE / SEED
NOT EXPOSED
DURING
POLLINATION**



ANGIOSPERM POLLINATION

ANGIOSPERMS



 = POLLIN GRAIN



PLANT 1

FLOWER



PLANT 2

FLOWER

ANGIOSPERMS



 = POLLIN GRAIN



PLANT 1

FLOWER



PLANT 2

FLOWER

ANGIOSPERMS



 = POLLIN GRAIN



PLANT 1

FLOWER



PLANT 2

FLOWER

ANGIOSPERMS

 = POLLIN GRAIN



PLANT 1

FLOWER

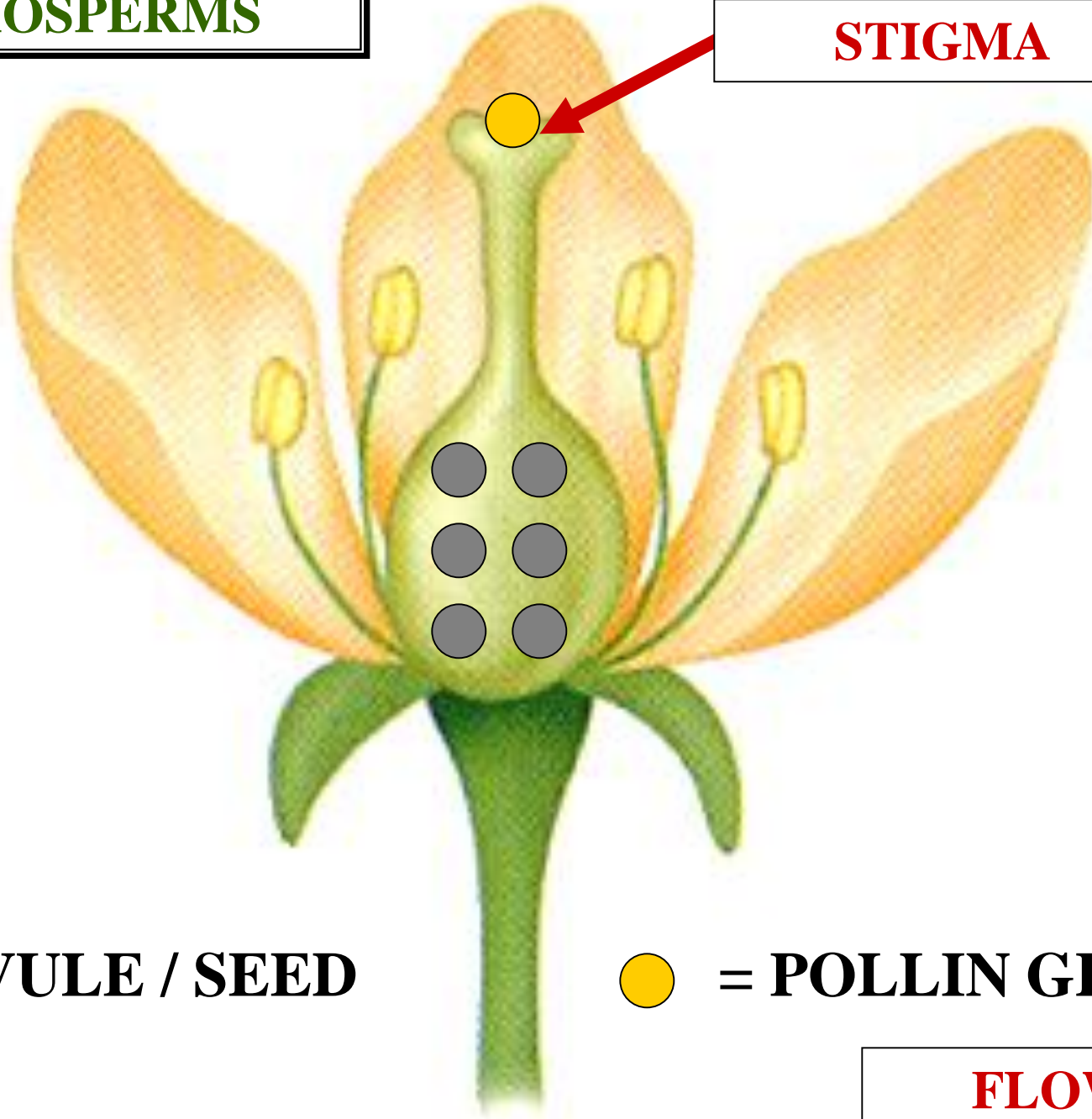


PLANT 2

FLOWER

ANGIOSPERMS

STIGMA



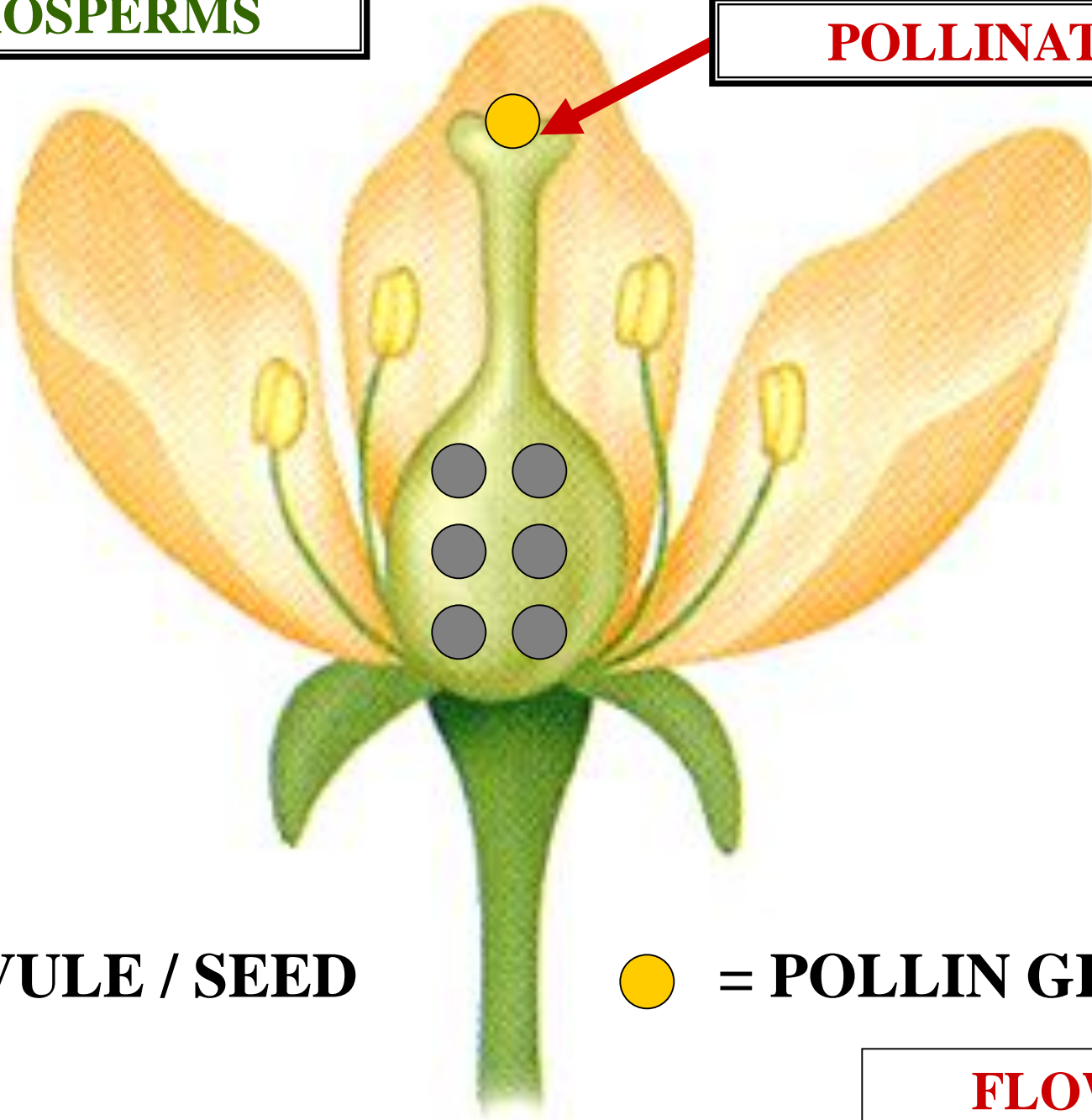
● = OVULE / SEED

● = POLLIN GRAIN

FLOWER

ANGIOSPERMS

POLLINATION



^
G

● = OVULE / SEED

● = POLLIN GRAIN

FLOWER



GYMNOSPERM POLLINATION

MICROSTROBILUS

PINUS

W



POLLIN GRAINS

MICROSTROBILUS

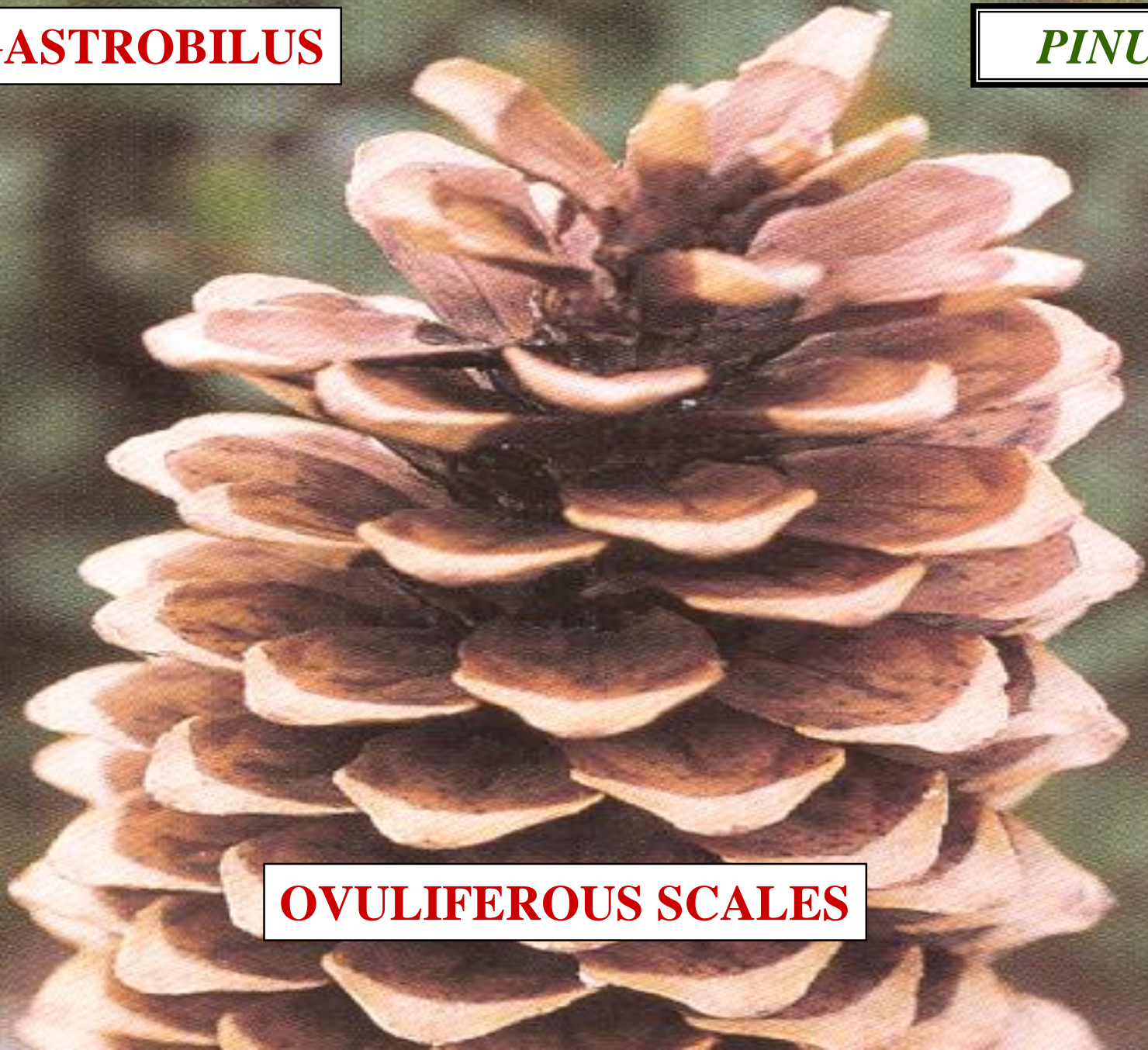
PINUS



WIND DISSEMINATED

MEGASTROBILUS

PINUS



OVULIFEROUS SCALES

MEGASTROBILUS



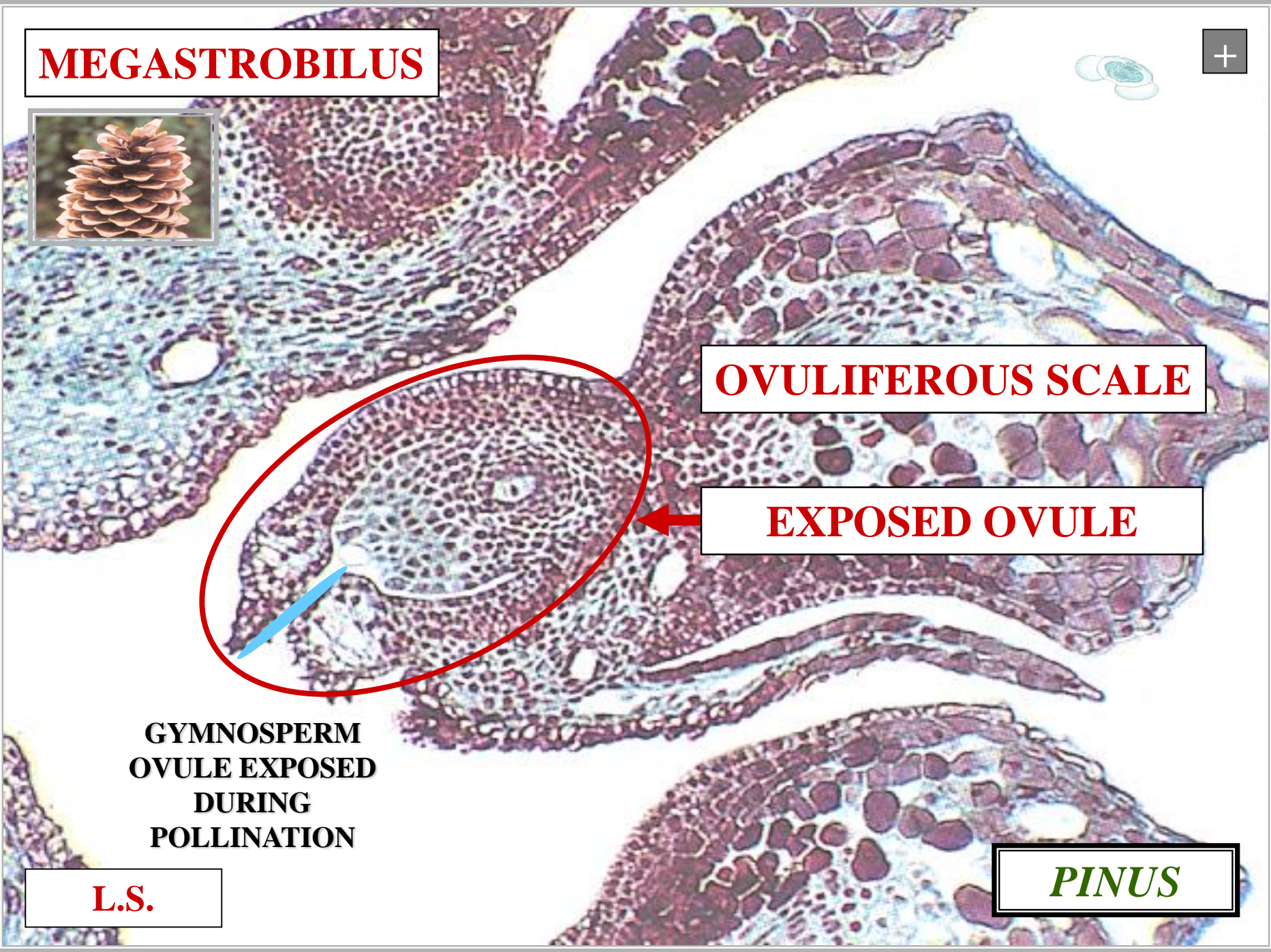
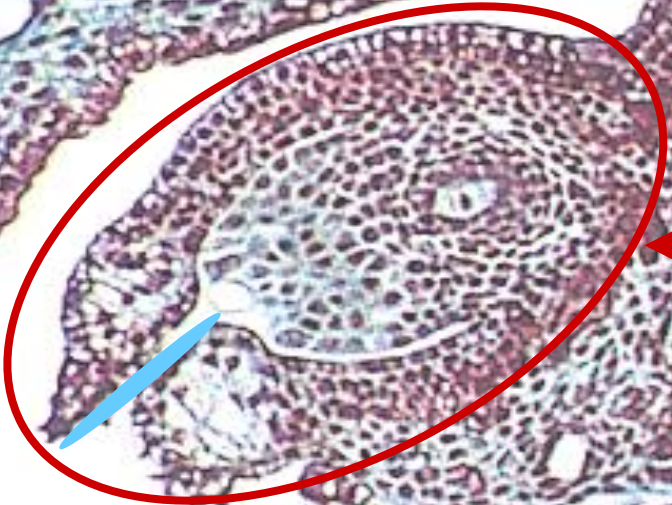
OVULIFEROUS SCALE

EXPOSED OVULE

**GYMNOSPERM
OVULE EXPOSED
DURING
POLLINATION**

L.S.

PINUS



MEGASTROBILUS

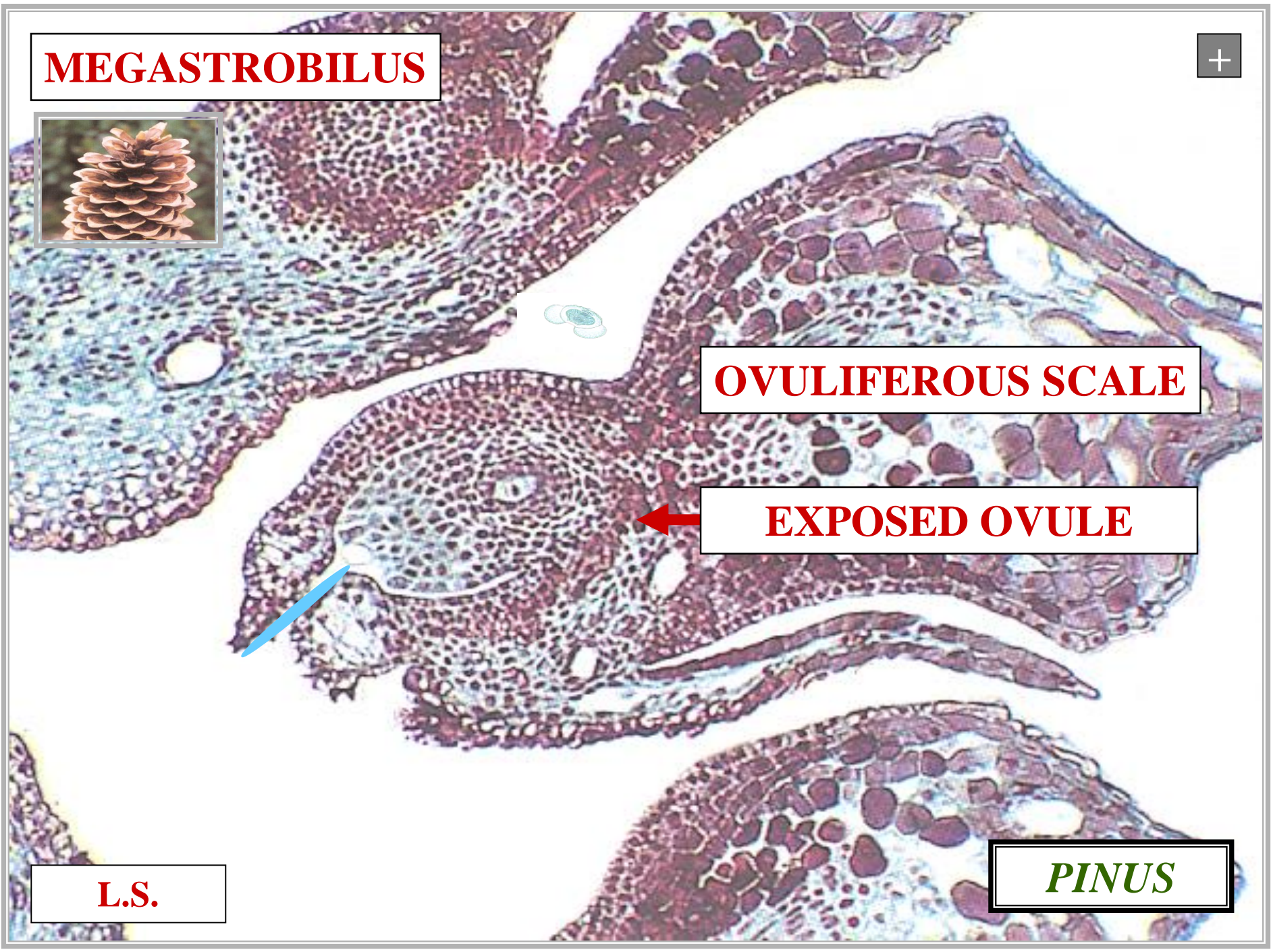


OVULIFEROUS SCALE

EXPOSED OVULE

L.S.

PINUS



MEGASTROBILUS



OVULIFEROUS SCALE

EXPOSED OVULE



L.S.

PINUS