ENVIRONMENTAL ADAPTATIONS OF
COASTAL CALIFORNIA PLANTS
IN THIS PAPER WE INVESTIGATE TWO QUESTIONS...
1) HOW DO NATIVE PLANTS ADJUST THEIR FUNCTIONAL TRAITS FOR DIFFERENT ENVIROINMENTAL CONDITIONS?
&
2) WHICH OF THE FIVE STUDY SPECIES ARE WEll-SUITED FOR DROUGHT AND COMPETITION?
STUDY BY
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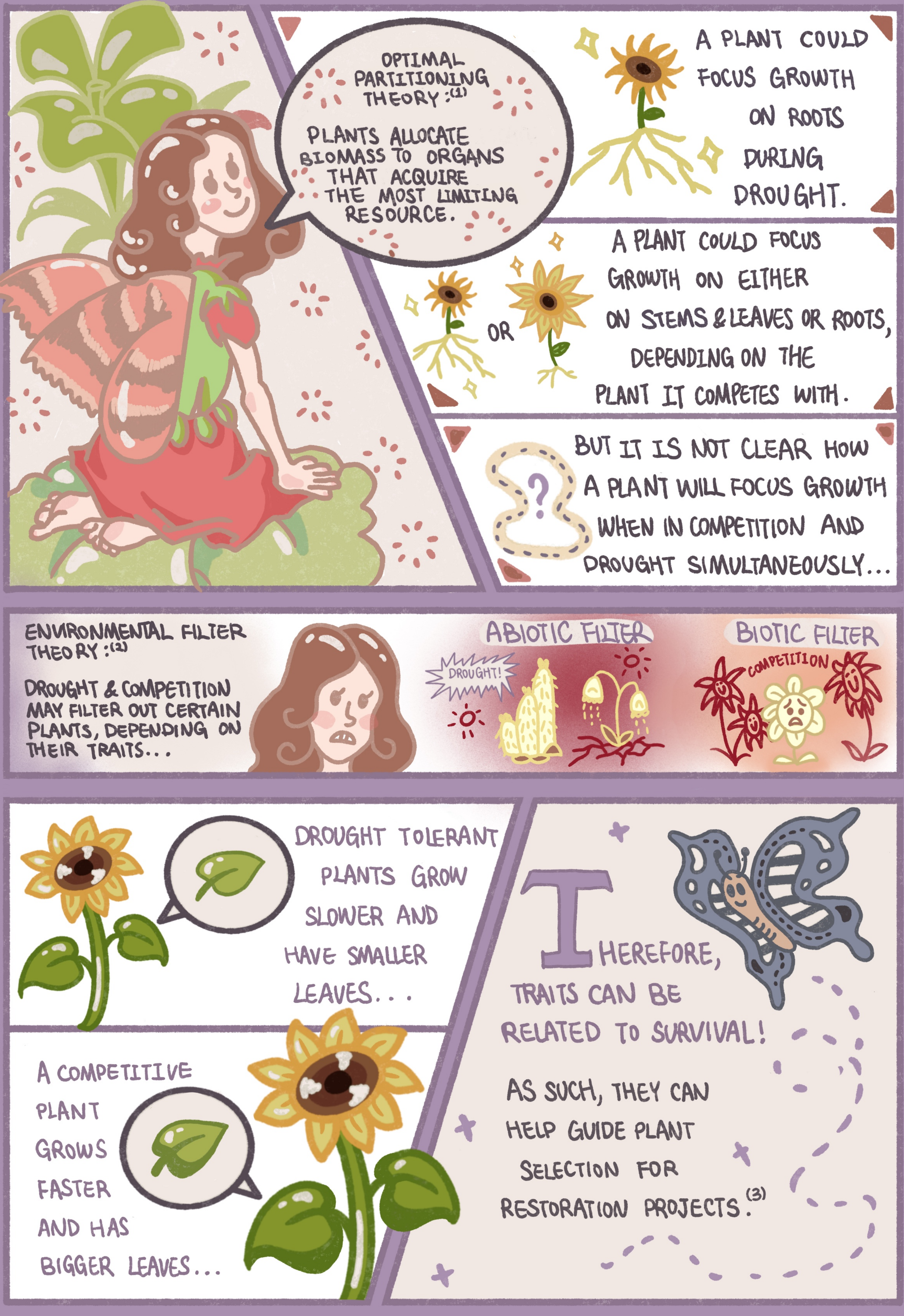
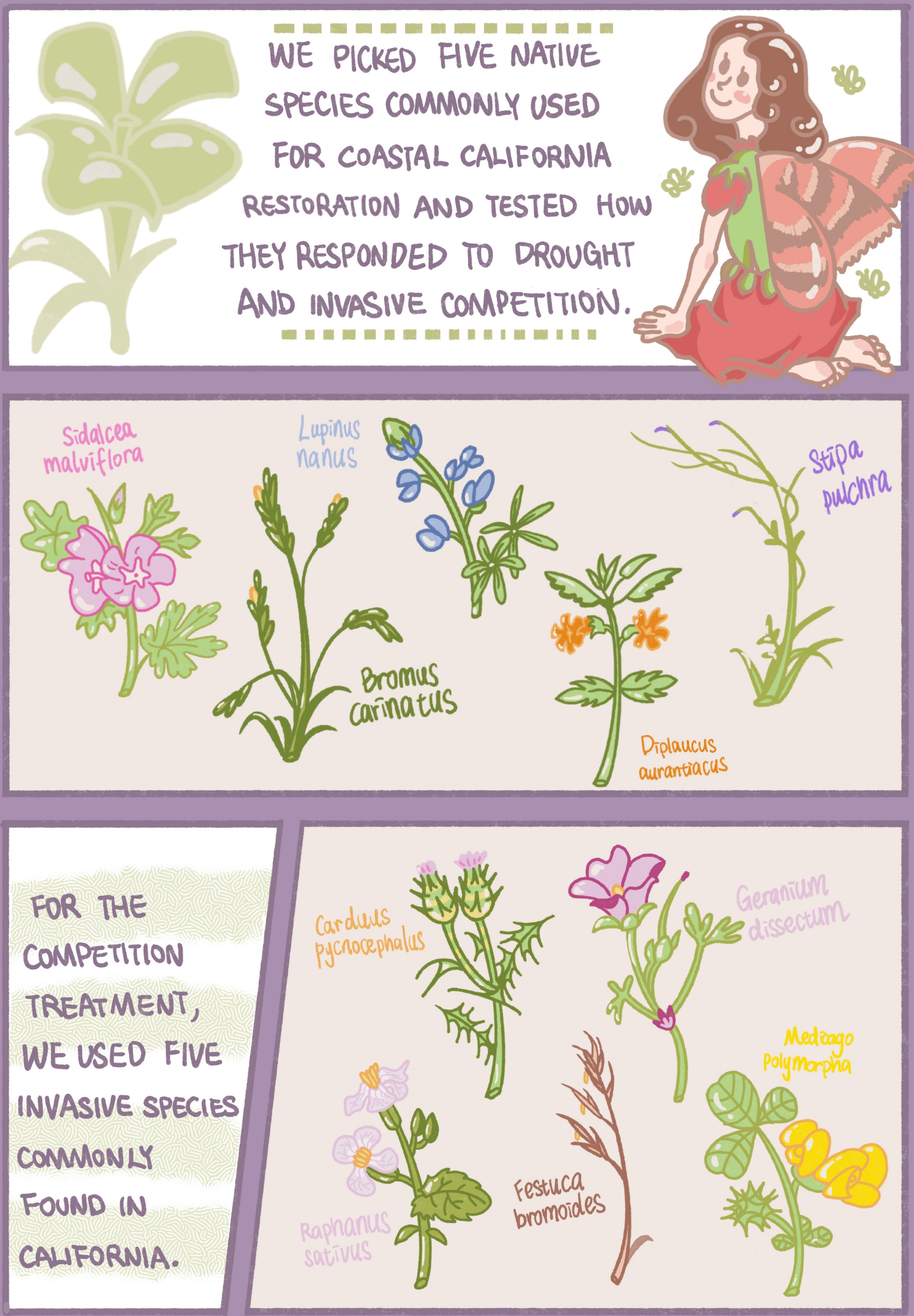
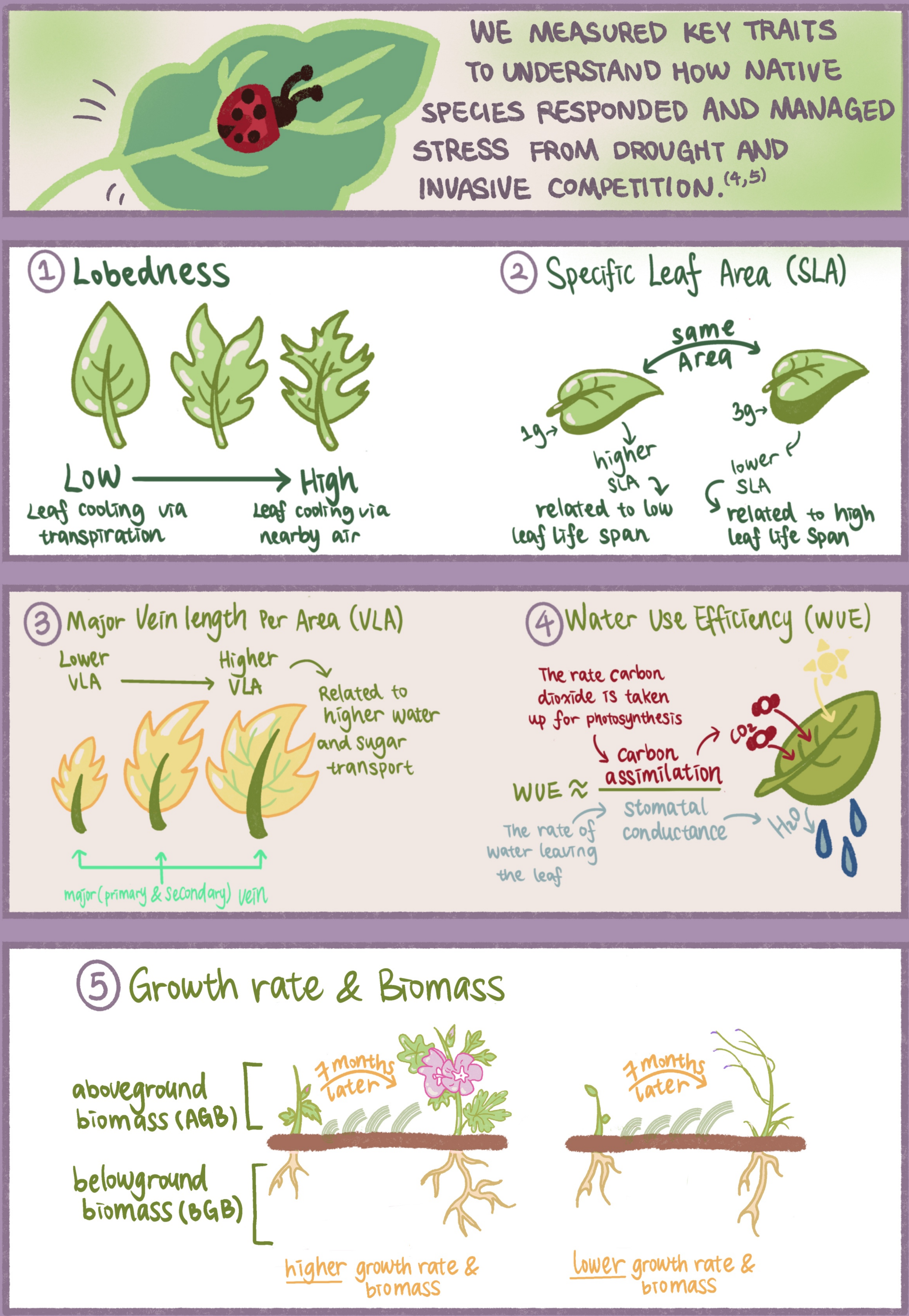

OPTIMAL PARTITIONING THEORY:(1)
PLANTS ALLOCATE BIOMASS TO ORGANS THAT ACQUIRE THE MOST LIMITING RESOURCE.
A PLANT COULD FOCUS GROWTH ON ROOTS DURING DROUGHT.
OR
A PLANT COULD FOCUS GROWTH ON EITHER ON STEMS & LEAVES OR ROOTS, DEPENDING ON THE PLANT IT COMPETES WITH.
?
BUT IT IS NOT CLEAR HOW A PLANT WILL FOCUS GROWTH WHEN IN COMPETITION AND DROUGHT SIMULTANEOUSLY...
ENVIRONMENTAL FILTER THEORY:(2)
DROUGHT & COMPETITION MAY FILTER OUT CERTAIN PLANTS, DEPENDING ON THEIR TRAITS...
ABIOTIC FILTER
DROUGHT!
BIOTIC FILTER
COMPETITION
DROUGHT TOLERANT PLANTS GROW SLOWER AND HAVE SMALLER LEAVES...
A COMPETITIVE PLANT GROWS FASTER AND HAS BIGGER LEAVES...
THEREFORE, TRAITS CAN BE RELATED TO SURVIVAL!
AS SUCH, THEY CAN HELP GUIDE PLANT SELECTION FOR RESTORATION PROJECTS.(3)


WE PICKED FIVE NATIVE SPECIES COMMONLY USED FOR COASTAL CALIFORNIA RESTORATION AND TESTED HOW THEY RESPONDED TO DROUGHT AND INVASIVE COMPETITION.
Sidalcea malviflora
Lupinus nanus
Bromus carinatus
Diplaucus aurantiacus
Stipa pulchra
FOR THE COMPETITION TREATMENT, WE USED FIVE INVASIVE SPECIES COMMONLY FOUND IN CALIFORNIA.
Carduus pycnocephalus
Geranium dissectum
Medicago Polymorpha
Raphanus sativus
Festuca bromoides



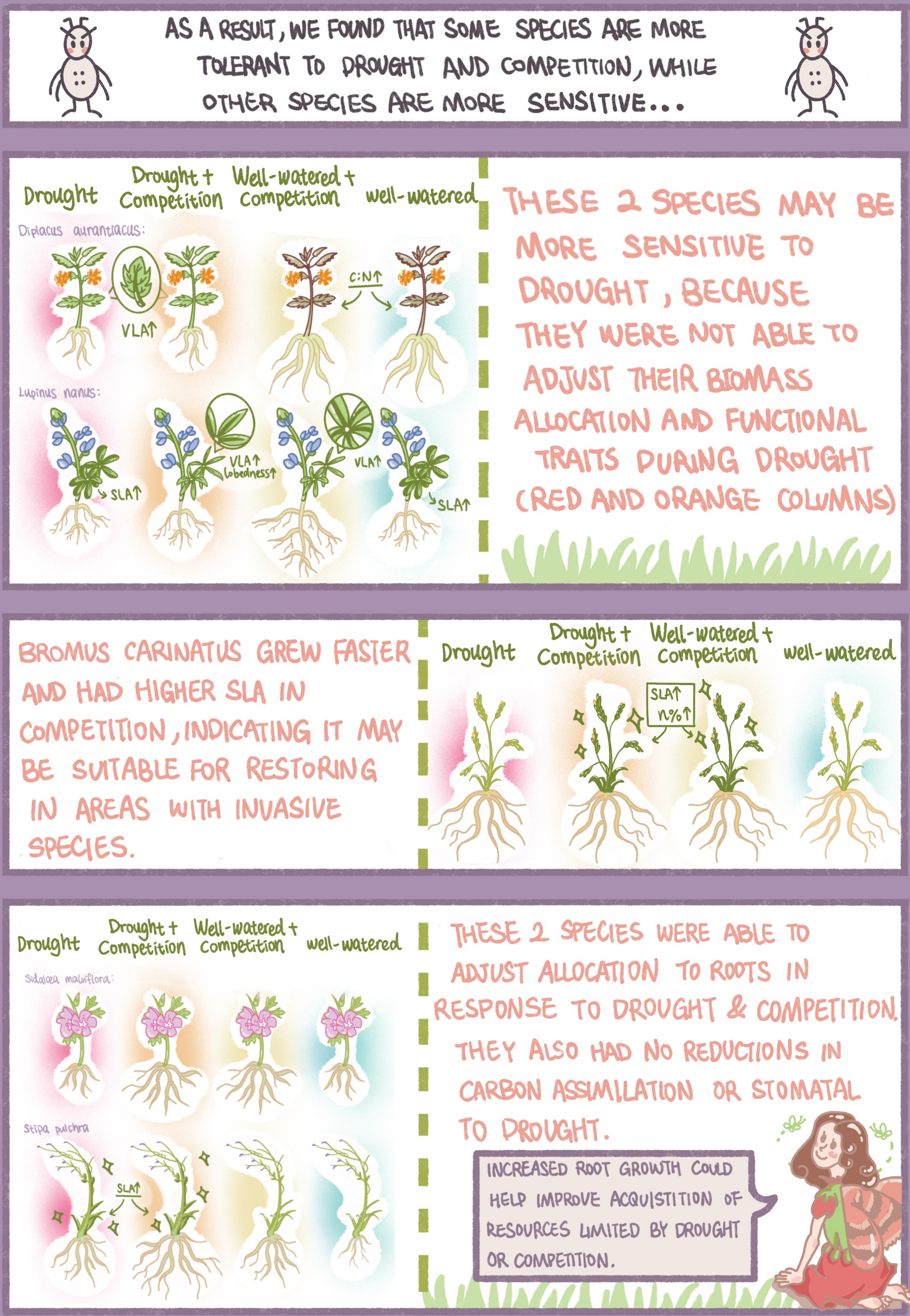
WE MEASURED KEY TRAITS TO UNDERSTAND HOW NATIVE SPECIES RESPONDED AND MANAGED STRESS FROM DROUGHT AND INVASIVE COMPETITION.[4,5]
1 Lobedness
Low
High
Leaf cooling via transpiration
Leaf cooling via nearby air
2 Specific Leaf Area (SLA)
same Area
1g
3g
higher SLA
related to low leaf life span
lower SLA
related to high leaf life span
3 Major Vein length Per Area (VLA)
Lower VLA
Higher VLA
Related to higher water and sugar transport
major (primary & secondary) vein
4 Water Use Efficiency (WUE)
The rate carbon dioxide is taken up for photosynthesis
carbon assimilation
WUE ≈
stomatal conductance
The rate of water leaving the leaf
CO2
H2O
5 Growth rate & Biomass
aboveground biomass (AGB)
belowground biomass (BGB)
7 months later
7 months later
higher growth rate & biomass
lower growth rate & biomass

WE SIMULATED FOUR DIFFERENT ENVIRONMENTAL TREATMENTS WITH A COMBINATION OF DROUGHT AND INVASIVE COMPETITION AND COMPARED THE GROWTH PATTERNS OF NATIVE SPECIE.

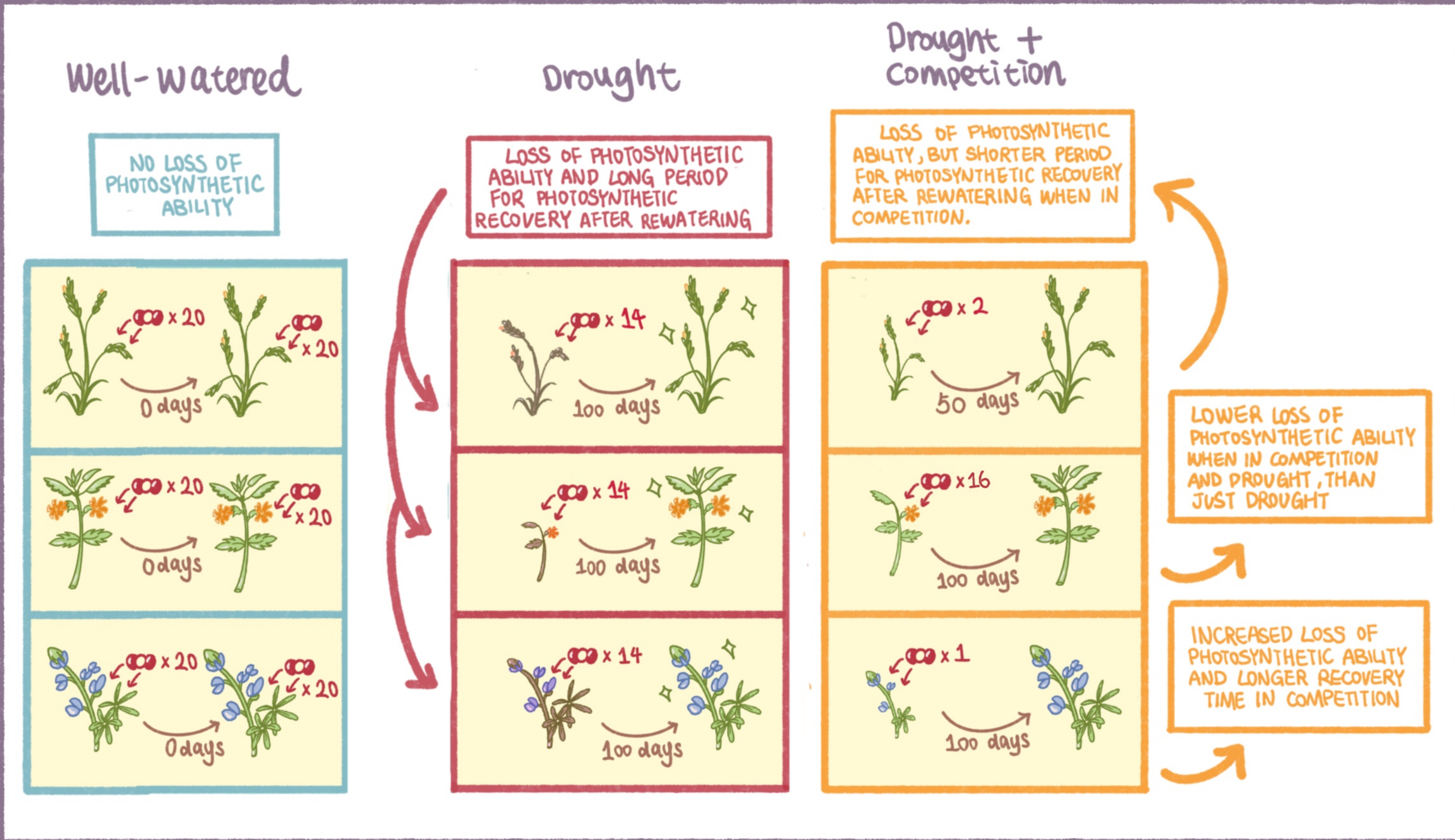
P.S.: THE "Well-watered" POT IS ALSO KNOWN AS THE CONTROL GROUP, WHICH DOES NOT RECEIVE ANY EXPERIMENTAL TREATMENT.

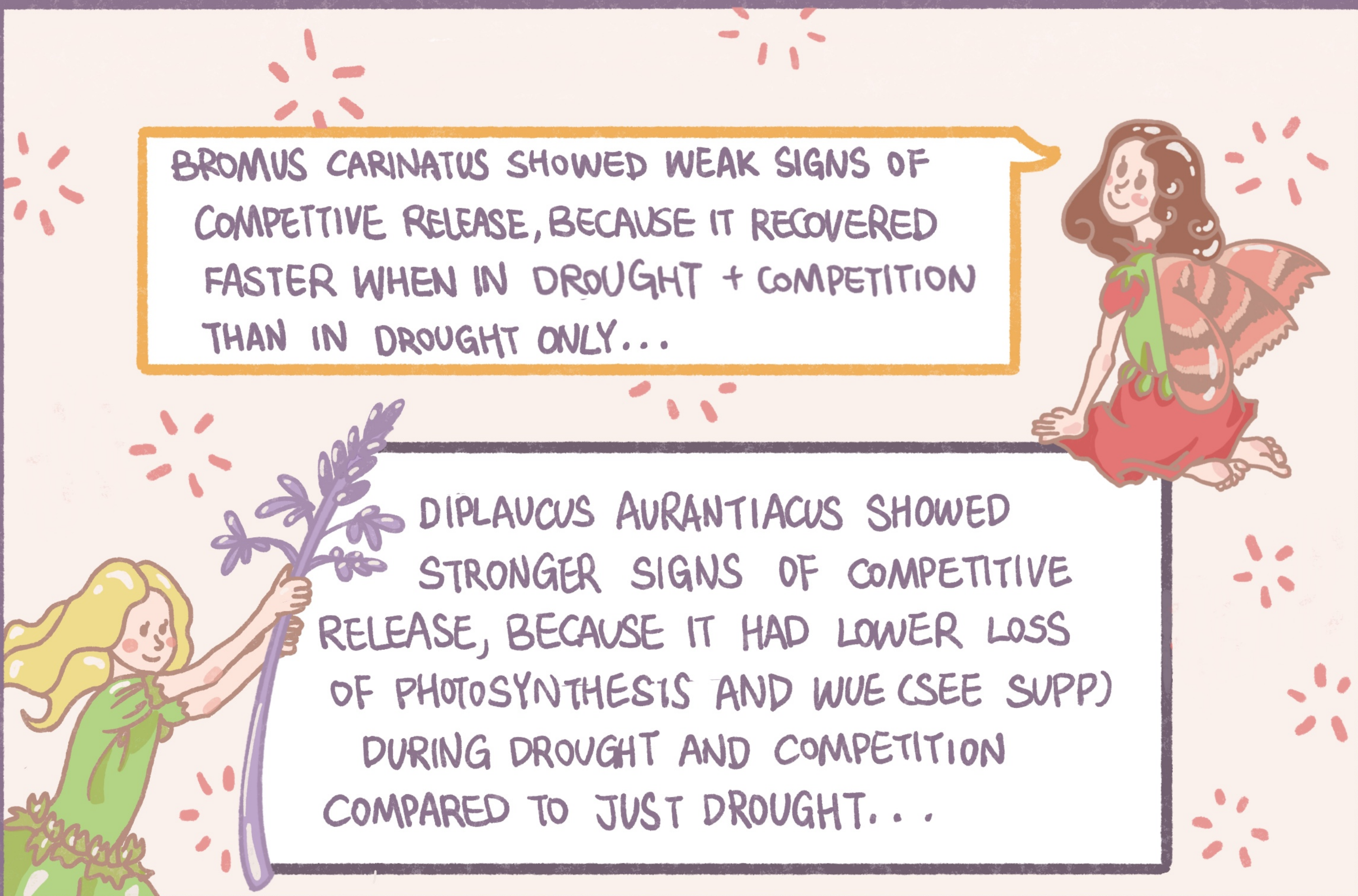
INVASIVE SPECIES WERE SHOWN AT DENSITIES EQUIVALENT TO THOSE OBSERVED IN THE FEILD.

EXPERIMENTAL DESIGNS:


AS A RESULT, WE FOUND THAT SOME SPECIES ARE MORE TOLERANT TO DROUGHT AND COMPETITION, WHILE OTHER SPECIES ARE MORE SENSITIVE...
Drought
Drought + Competition
Well-watered + Competition
well-watered
Diplacus aurantiacus:
VLA↑
C:N↑
Lupinus nanus:
SLA↑
VLA↑ lobedness↑
VLA↑
SLA↑
THESE 2 SPECIES MAY BE MORE SENSITIVE TO DROUGHT, BECAUSE THEY WERE NOT ABLE TO ADJUST THEIR BIOMASS ALLOCATION AND FUNCTIONAL TRAITS DURING DROUGHT (RED AND ORANGE COLUMNS)
BROMUS CARINATUS GREW FASTER AND HAD HIGHER SLA IN COMPETITION, INDICATING IT MAY BE SUITABLE FOR RESTORING IN AREAS WITH INVASIVE SPECIES.
Drought
Drought + Competition
Well-watered + Competition
well-watered
SLA↑
N%↑
Drought
Drought + Competition
Well-watered + Competition
well-watered
Sidalcea malviflora:
Stipa pulchra
SLA↑
THESE 2 SPECIES WERE ABLE TO ADJUST ALLOCATION TO ROOTS IN RESPONSE TO DROUGHT & COMPETITION. THEY ALSO HAD NO REDUCTIONS IN CARBON ASSIMILATION OR STOMATAL TO DROUGHT.
INCREASED ROOT GROWTH COULD HELP IMPROVE ACQUISTITION OF RESOURCES LIMITED BY DROUGHT OR COMPETITION.

LOSS OF PHOTOSYNTHETIC ABILITY AND RECOVERY RATE AFTER DROUGHT:





CONCLUSION

1) NATIVE SPECIES HAVE DIVERSE RESPONSES TO DROUGHT AND INVASIVE SPECIES & RESULTS ARE CONSISTENT WITH OPTIMAL PARTITIONING THEORY AND ENVIRONMENTAL FILTER THEORY.

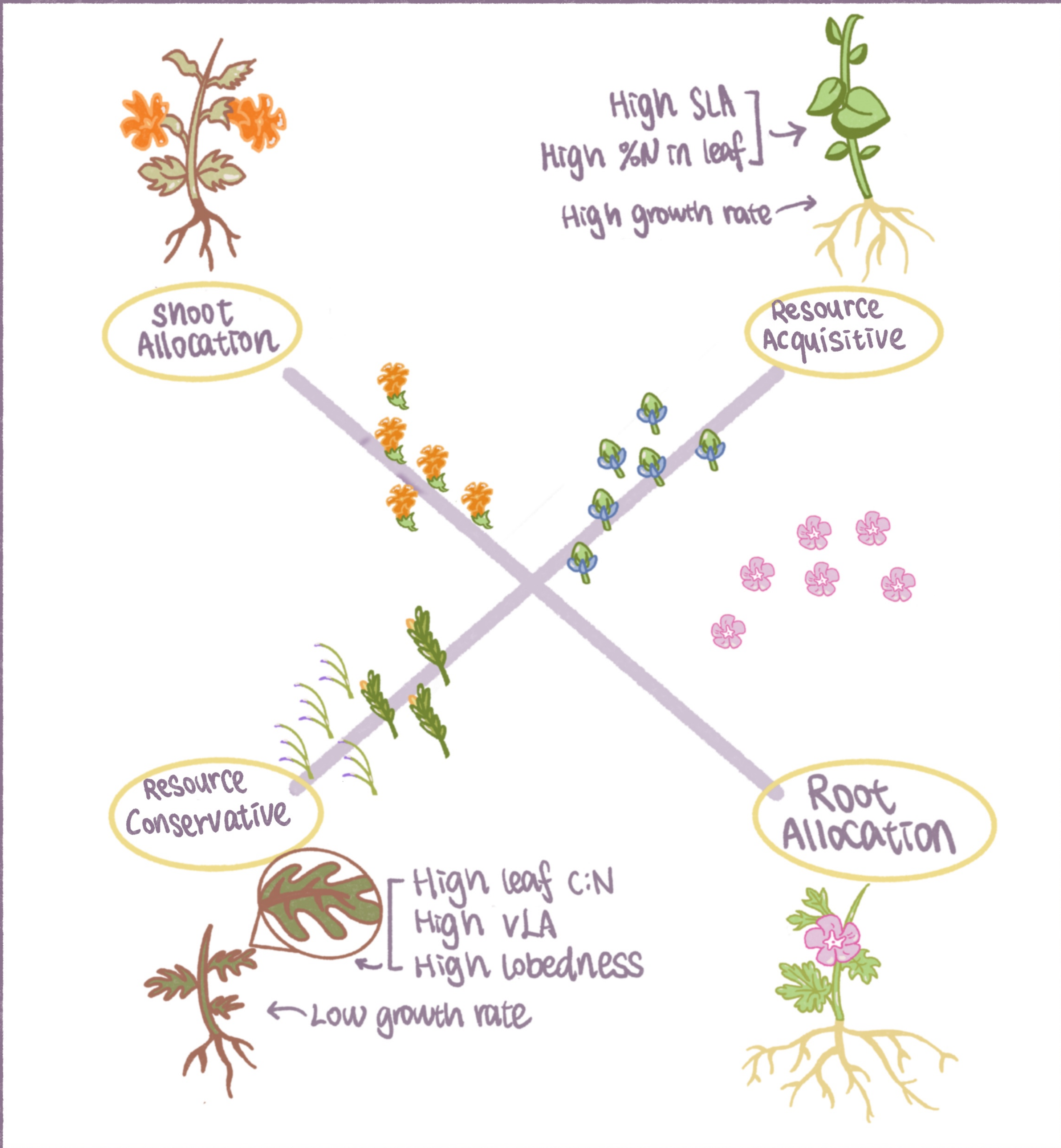
2) THE RESULTS IMPLY THAT   MAY BE EFFECTIVE SPECIES FOR COASTAL CALIFORNIA GRASS RESTORATION IN INVADED AREAS;

3)   MAY BE MORE USEFUL DURING DRY YEARS WHEN THERE'S LESS COMPETITION WHEREAS INTRODUCING  MAY BE MORE EFFECTIVE DURING WETTER YEARS.

SUPPLEMENTAL

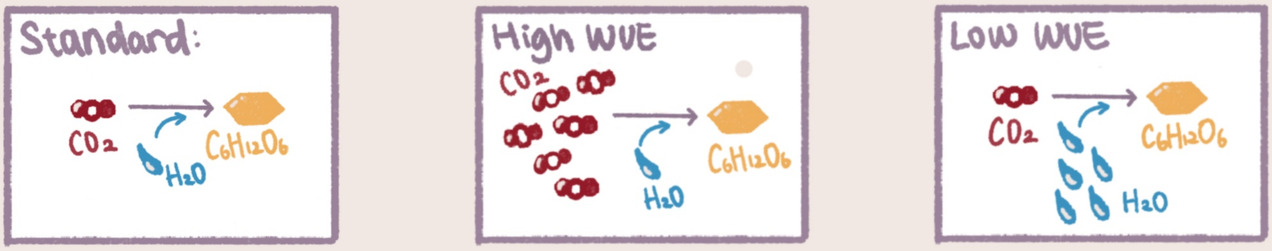
Trade-offs in growth responses

PLANTS HAVE TO BALANCE GROWTH PATTERNS IN ORDER TO SURVIVE, CONTRASTING ENVIRONMENTAL FILTERS. FOR EXAMPLE, IT IS UNCOMMON TO HAVE FOCUSED GROWTH IN BOTH ROOTS AND LEAVES DURING DIFFERENT STRESSORS.

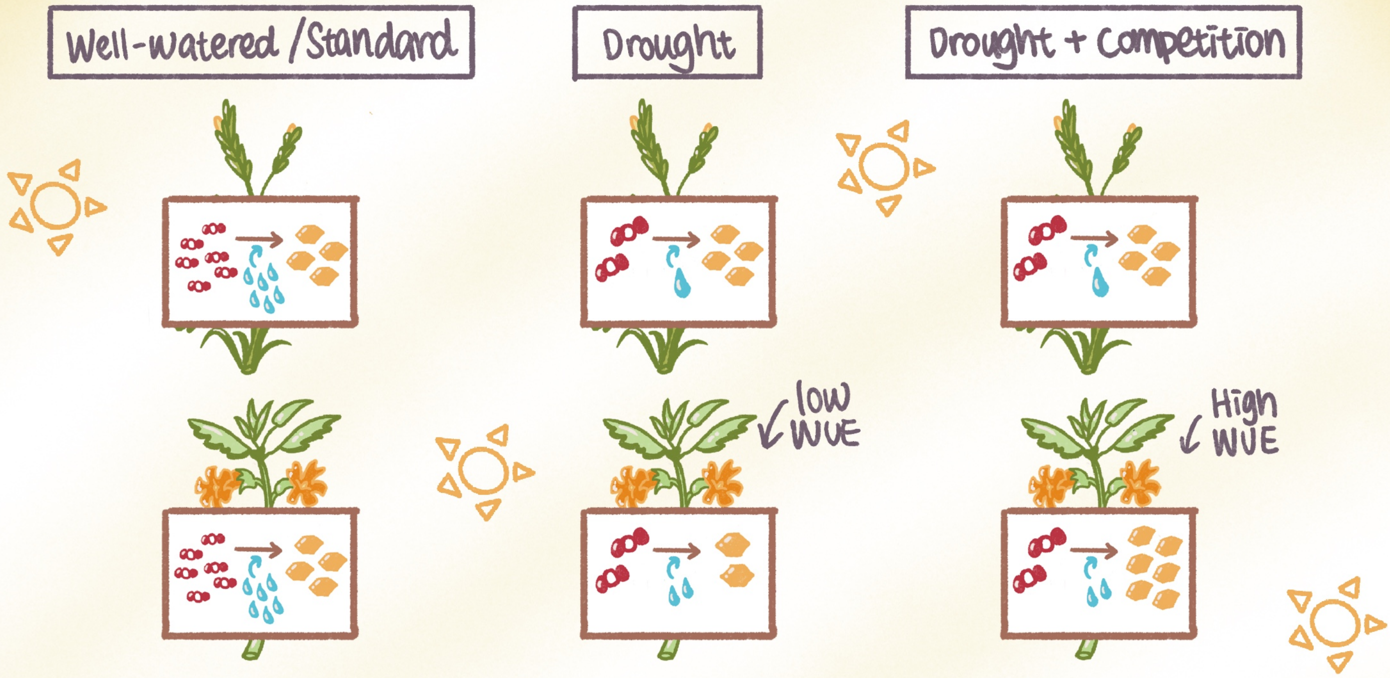


Leaf Gas Exchange

Reminder



STIPA PULCHRA AND SIDALCEA MALVIFLORA GAS EXCHANGE WERE NOT AFFECTED BY DROUGHT OR COMPETITION.

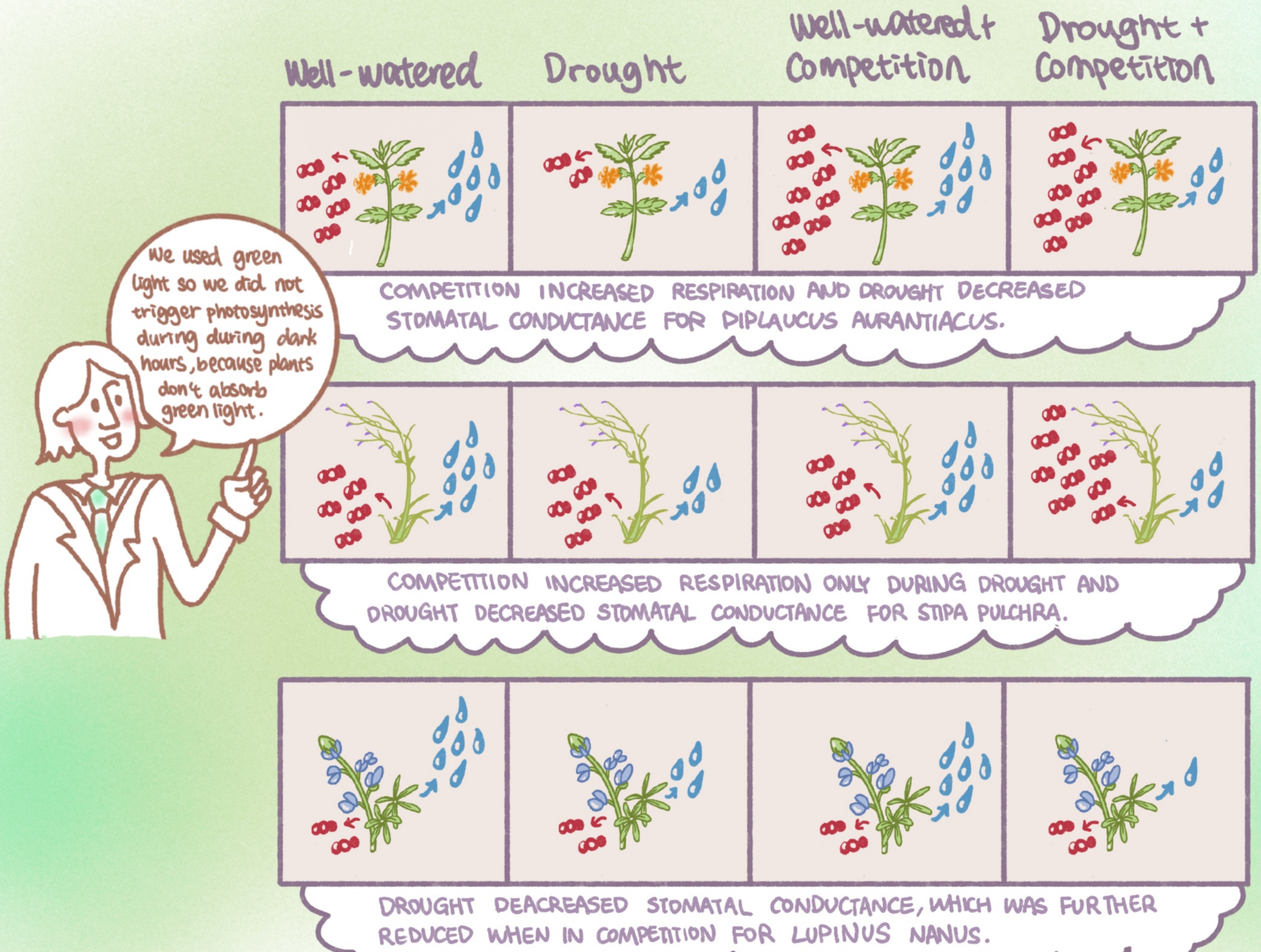


DIPLACUS AURANTIACUS HAD DECREASED CARBON ASSIMILATION AND STOMATAL CONDUCTANCE DURING DROUGHT, BUT HIGHER WUE WHEN IN BOTH COMPETITION AND DROUGHT.

DROUGHT DECREASED LUPINUS NANUS STOMATAL CONDUCTANCE CARBON ASSIMILATION. CARBON ASSIMILATION AND WUE FURTHER DECREASED DURING DROUGHT AND COMPETITION.

Nighttime WUE

DURING NIGHTTIME, PLANTS EXPERIENCE RESPIRATION INSTEAD OF PHOTOSYNTHESIS. RESPIRATION IS THE RELEASE OF CO_2 FROM THE LEAVES AS A RESULT OF THE DARK CIRCLE.



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