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MICRO-ECOLOGICAL LIFE SUPPORT SYSTEM ALTERNATIVE

CREATING A CIRCULAR FUTURE

Seed orientation affects seedling development in hardware for experiments in space

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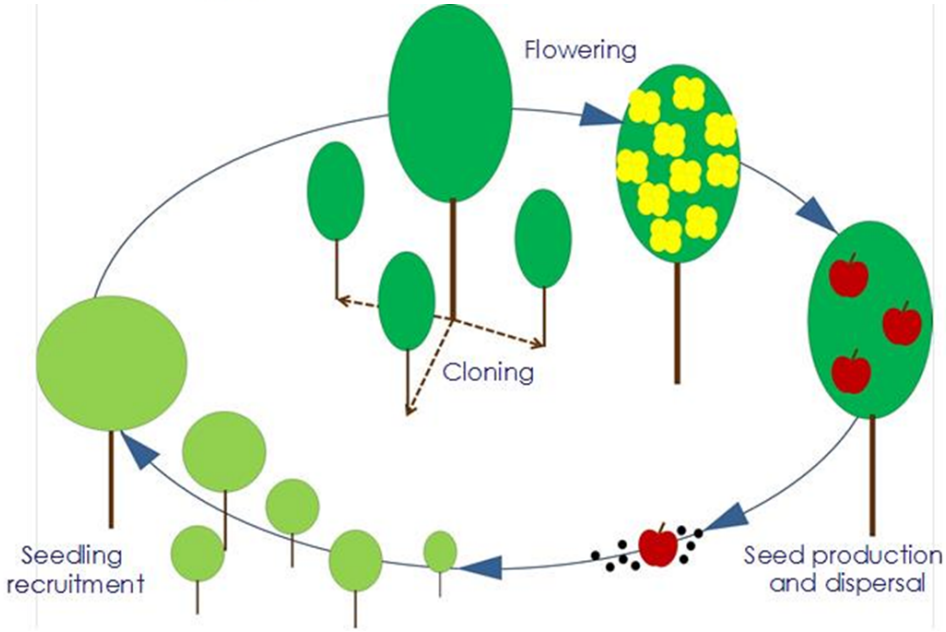
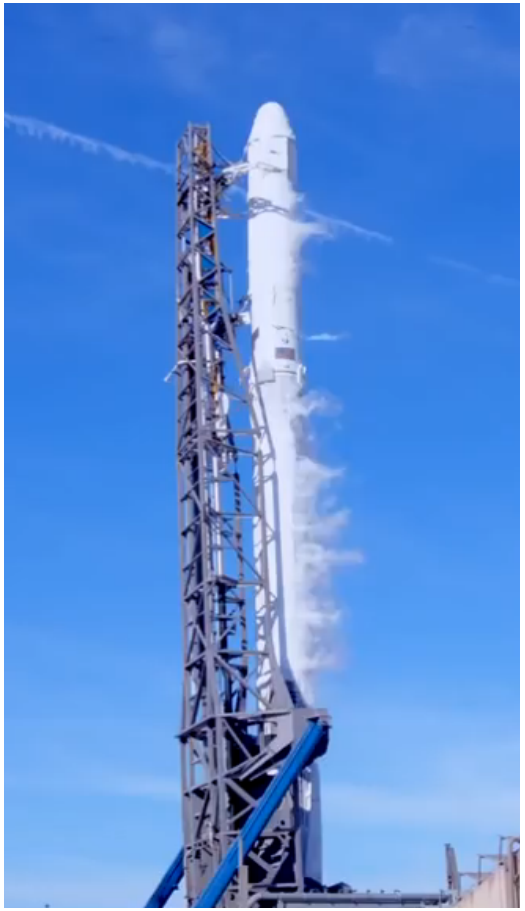
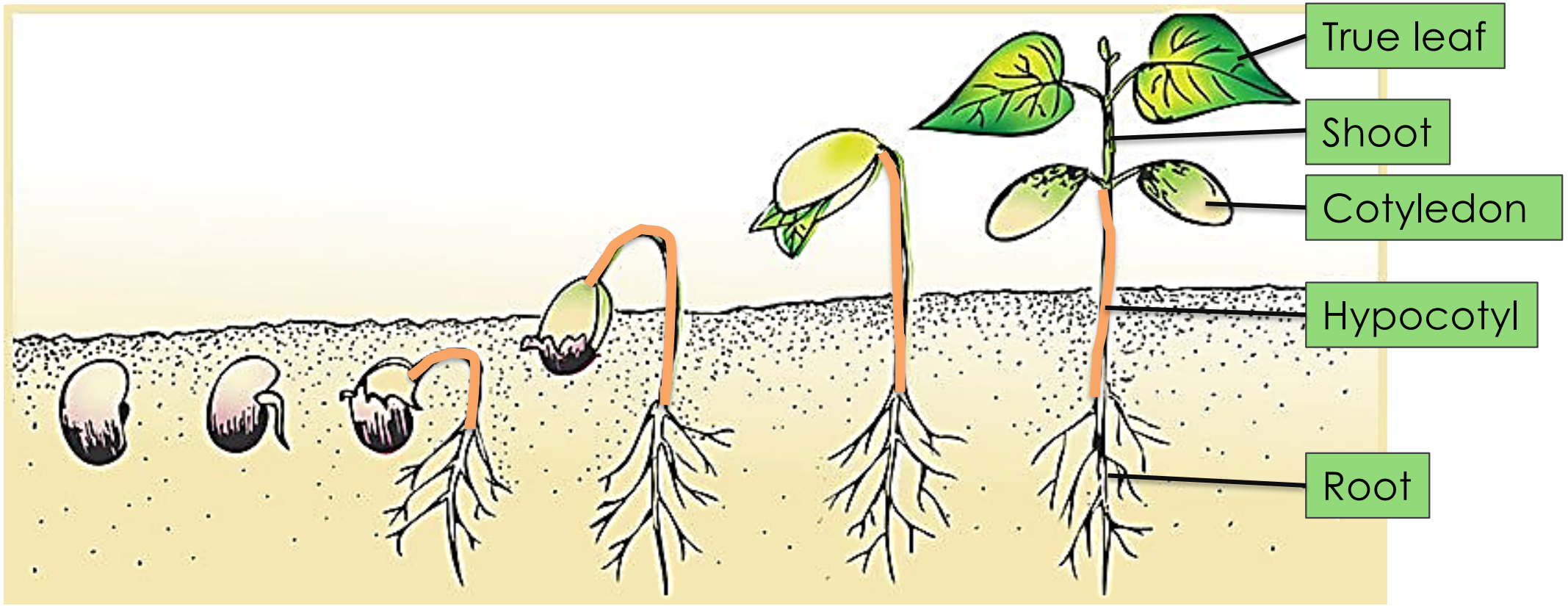
Seed traits in a scenario of space biology experiments



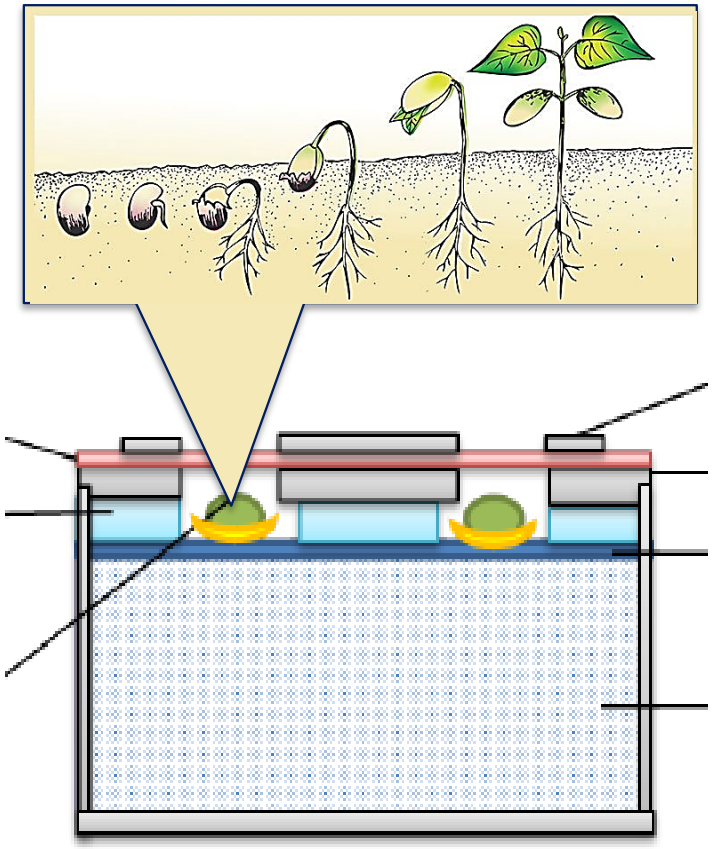


Seed represents the smallest individual plant (embryo),
is surrounded by nutritional tissue,
lives in a quiescent state

From dry seed to seedling with first true leaves

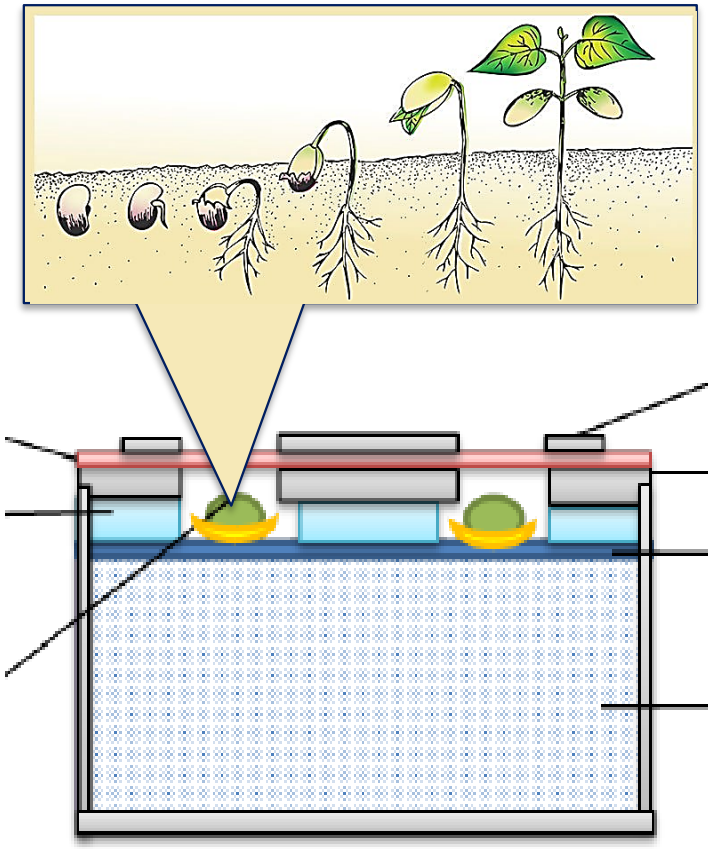


WAPS (Water Across the Plant Systems) experiment



WAPS is funded by ESA to be performed on ISS, in the BIOLAB

WAPS (Water Across the Plant Systems) experiment



WAPS Root Compartment:
seedling development up to the target stage

WAPS is funded by ESA to be performed on ISS, in the BIOLAB

WAPS: Seedling-hardware interactions

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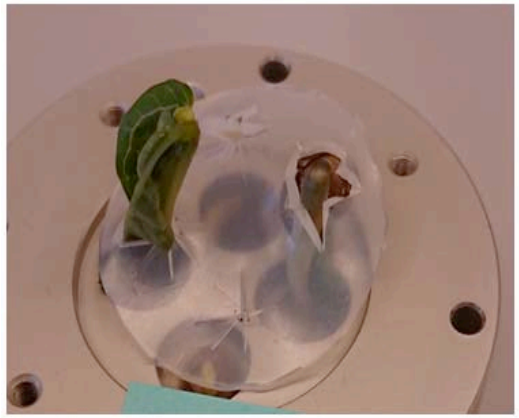
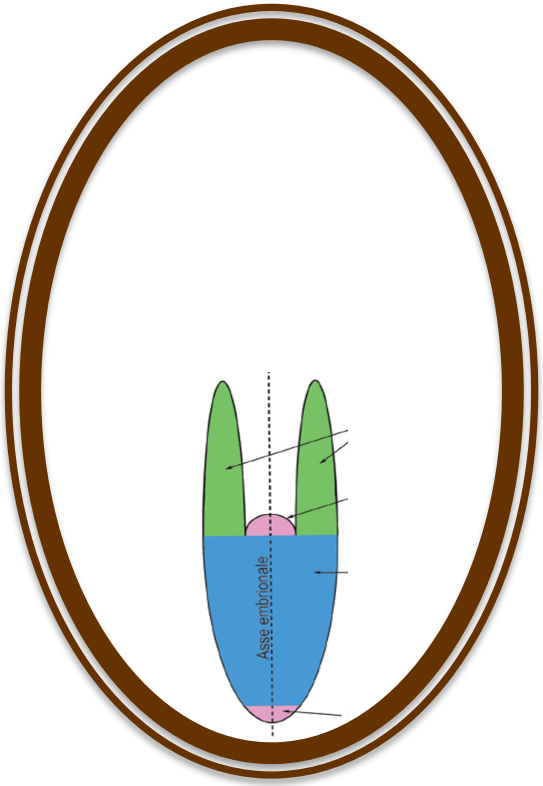
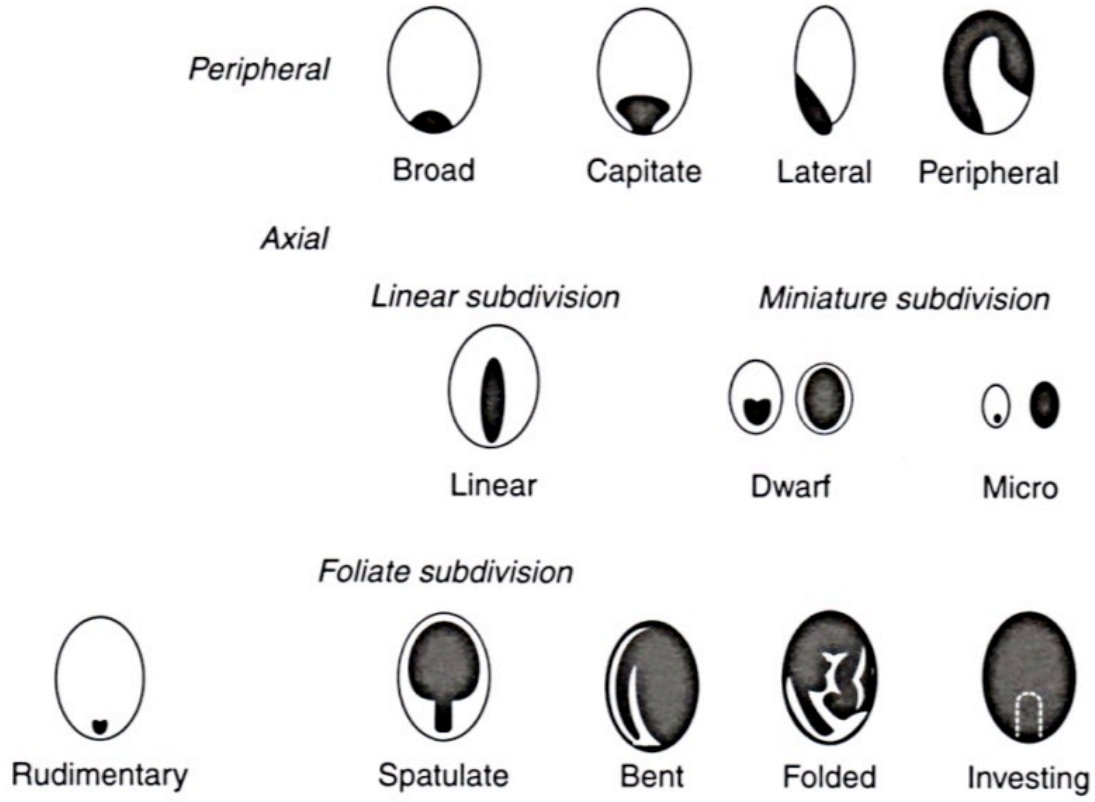
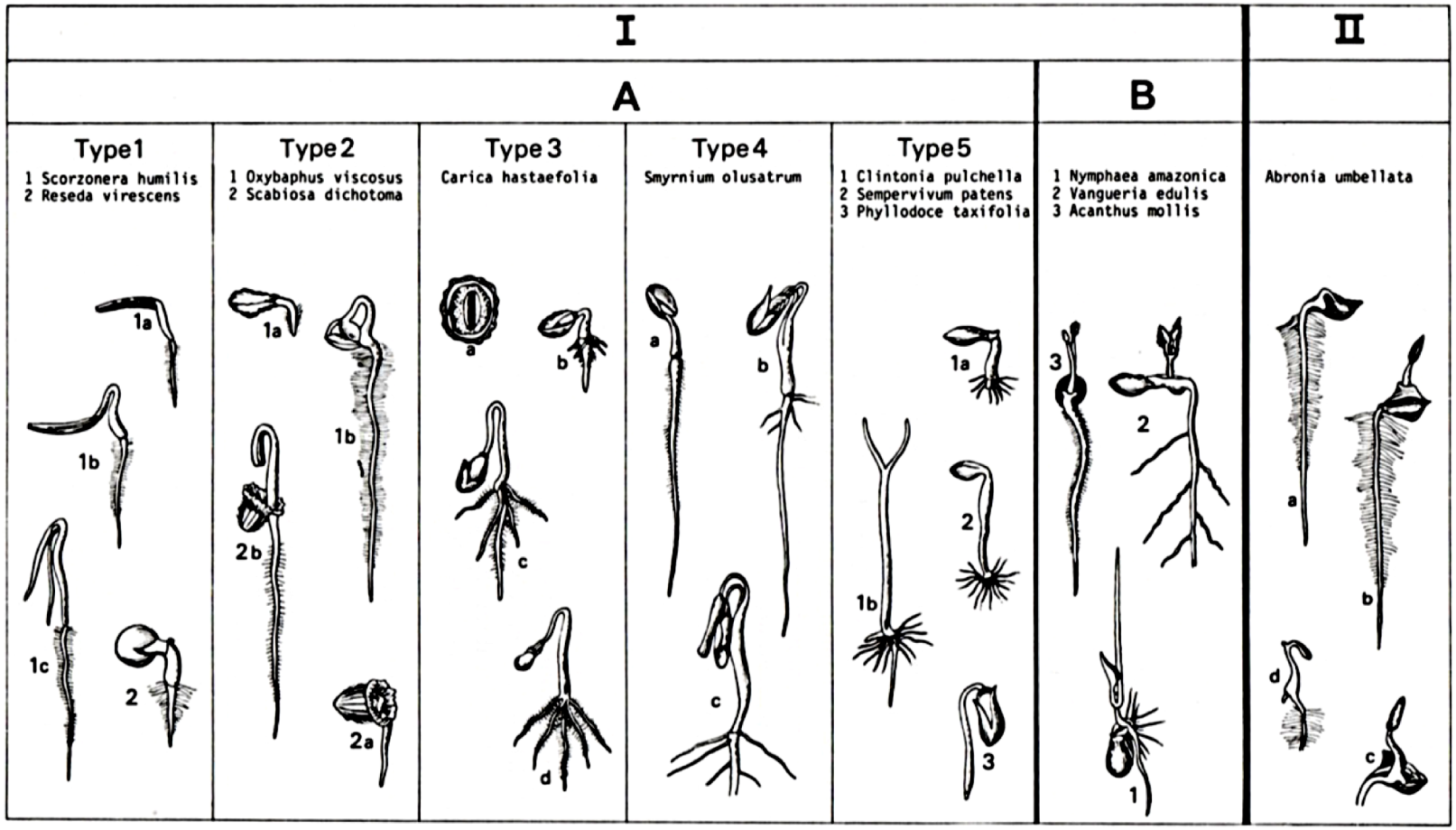


Seed embryo: morphology and classification



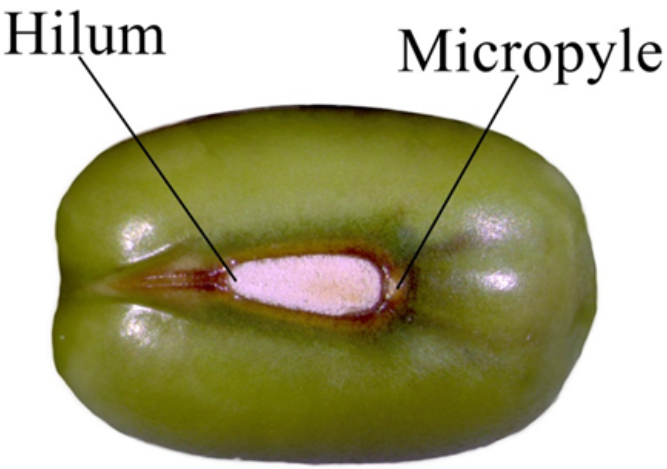


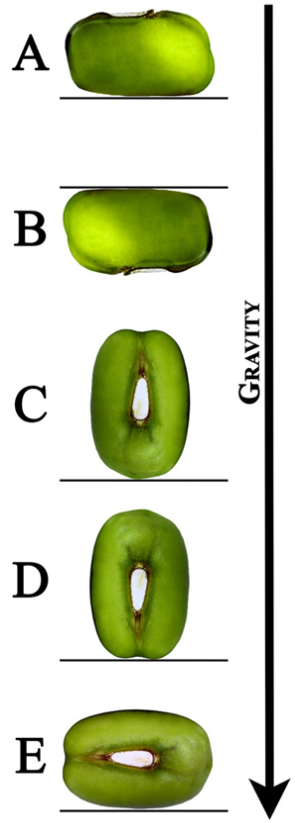
Seedling morphology and classification



(de Vogel, 1980)

Seed orientation and seedling growth: research question





Does seed orientation affect seedling growth and development?

Vigna radiata
seed length: about 5 mm

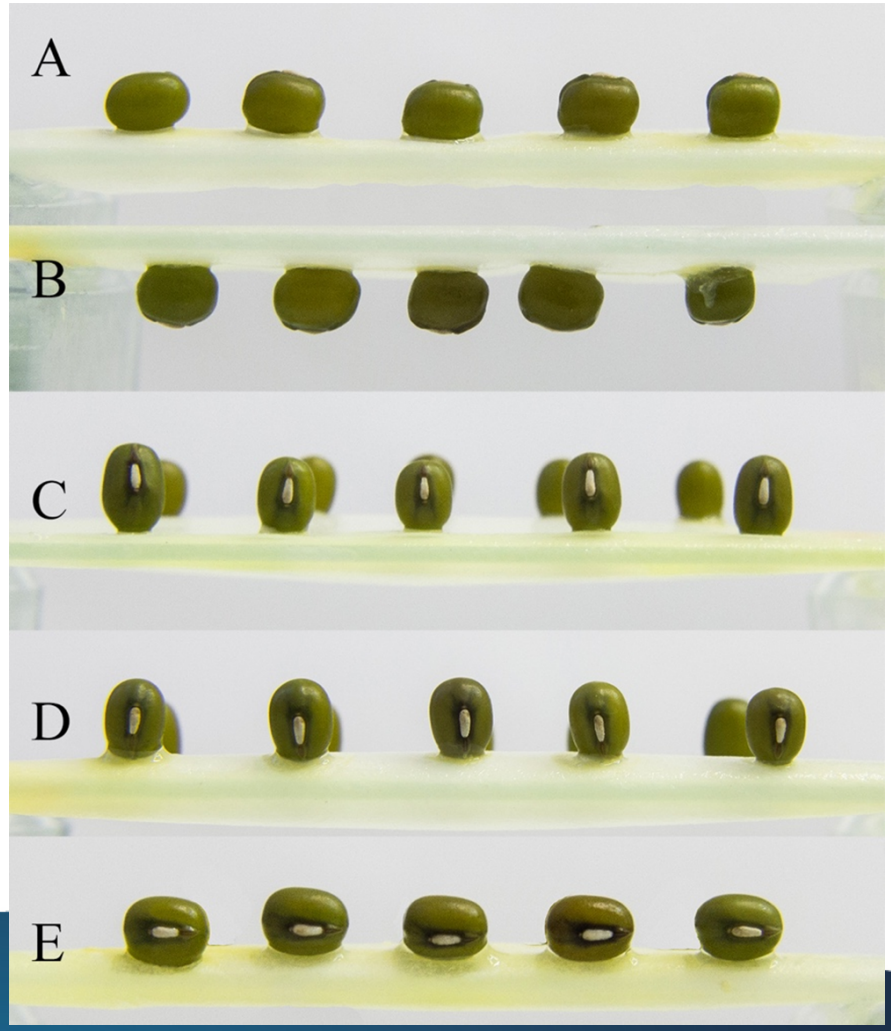
Seed orientation and seedling growth: experiment set-up

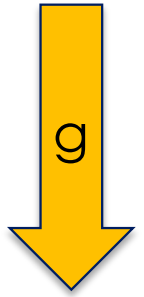
Dry seeds: ***Vigna radiata***

Temperature: 22° C

RH: ~100%

Light: ~100 $\mu mol \cdot m^{-2} \cdot s^{-1}$



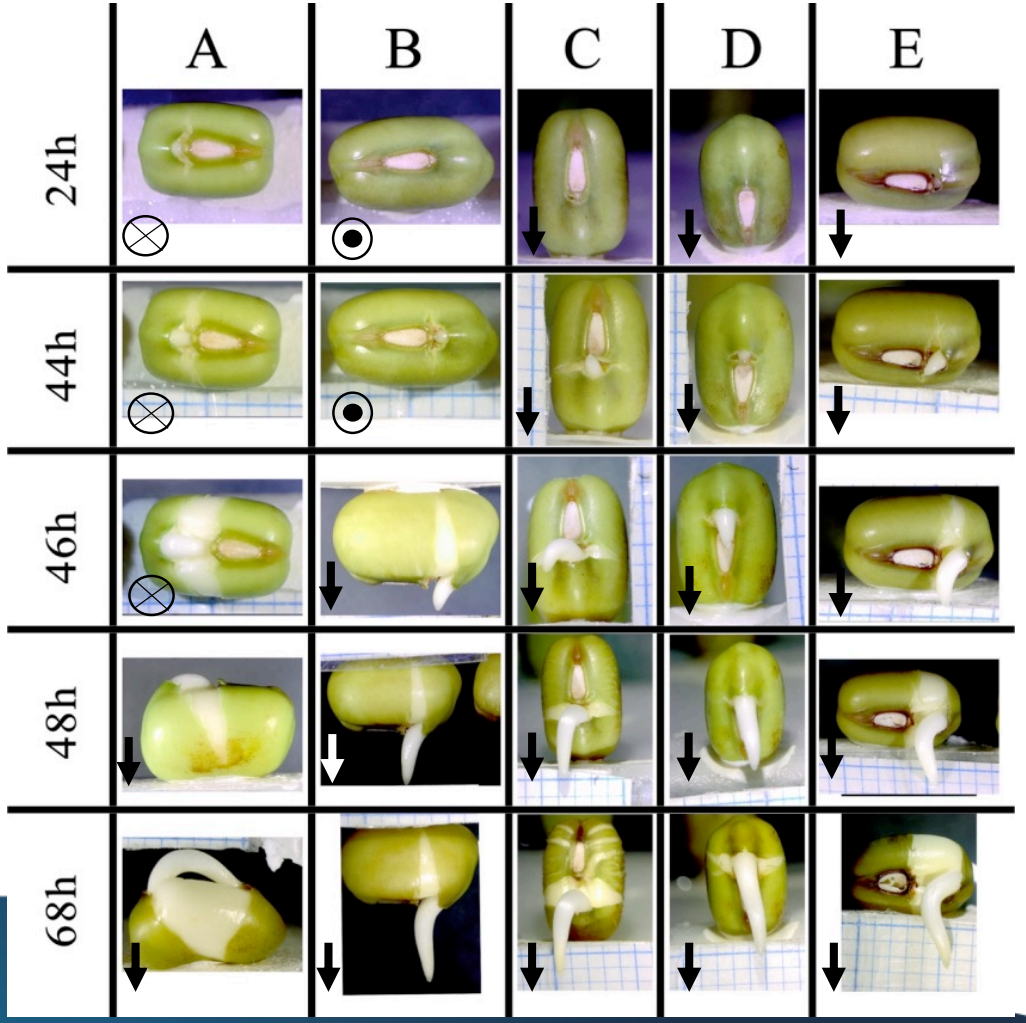


Seed orientation and seedling growth: sample analyses

Digital Images:
at 24, 44, 46, 48, 68h from sowing.

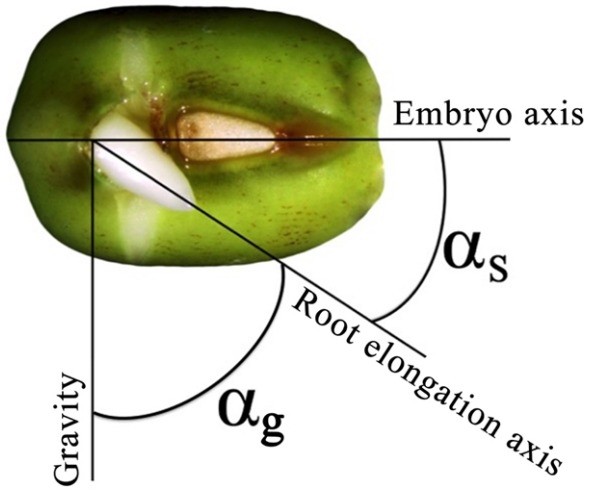
Digital Image Analysis:
ImageJ (Raspand, USA)

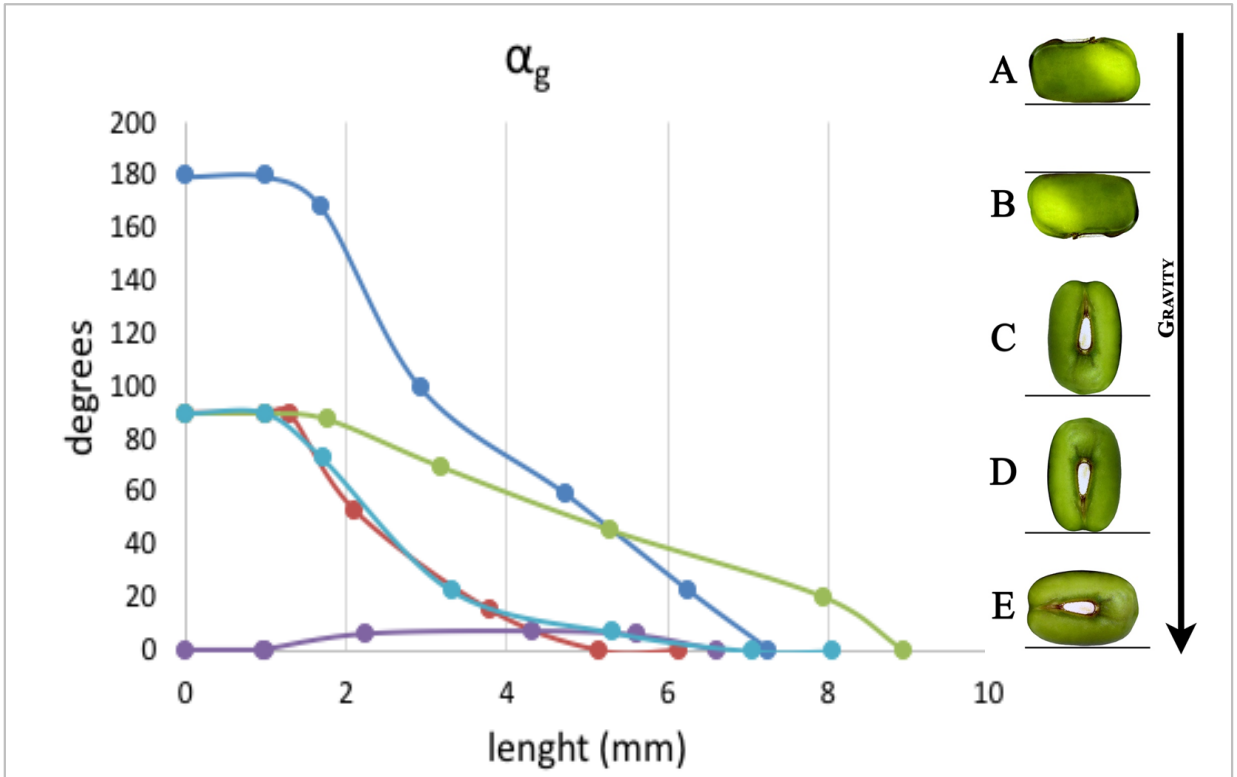
Measured parameters:
- time of radicle protrusion
- root length
- root growth rate
- root angles



Seed orientation and seedling growth: results

Root elongation and root angles of seeds at different orientations

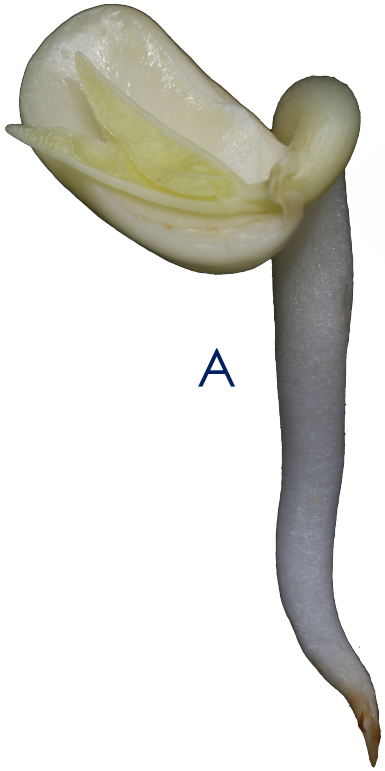




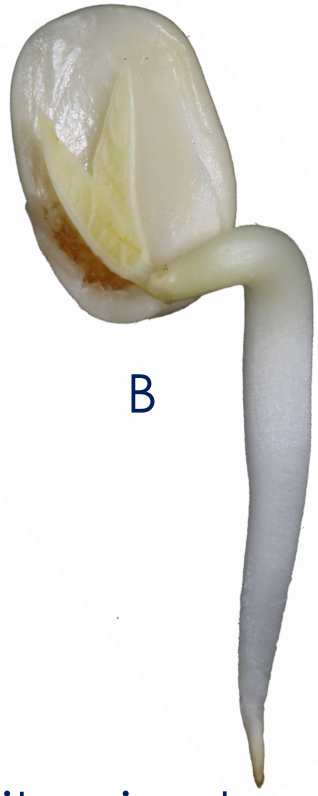
A = green line, B = red line, C = dark blue line, D = purple line, E = light blue line

Seed orientation: agravitropic and gravitropic growth

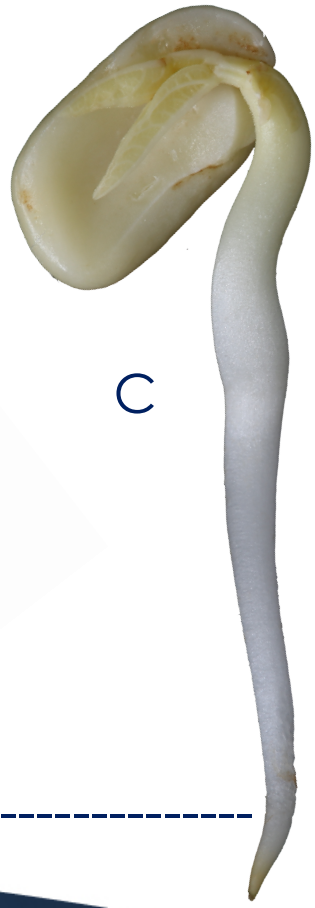
Agravitropic phase



A



B



C

g

---------- Gravitropic phase ----------

Seed orientation: possible scenarios in microgravity

Example A

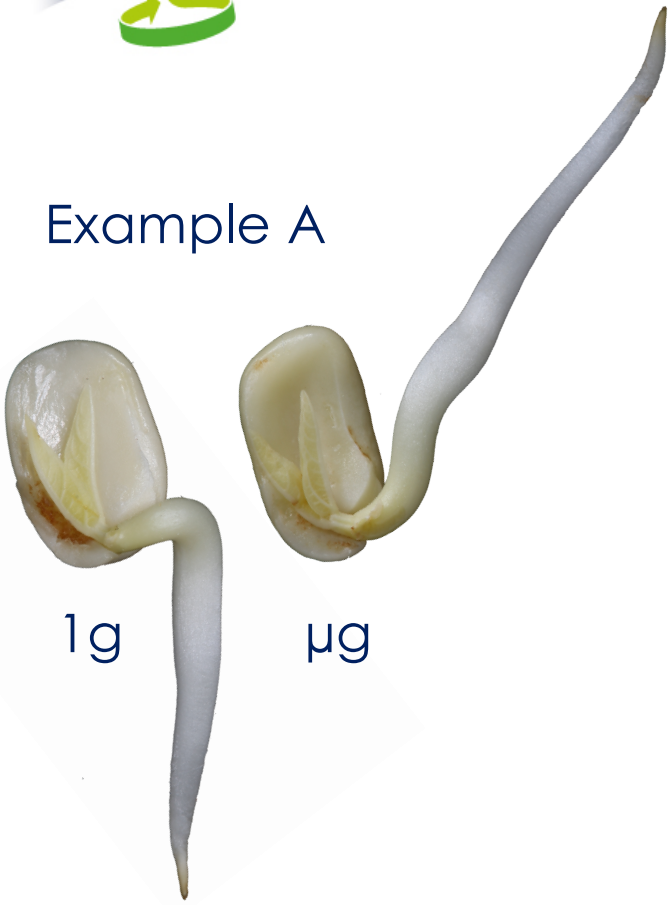
1g

Example B

1g

Seed orientation: possible scenarios in microgravity

Example A



1g

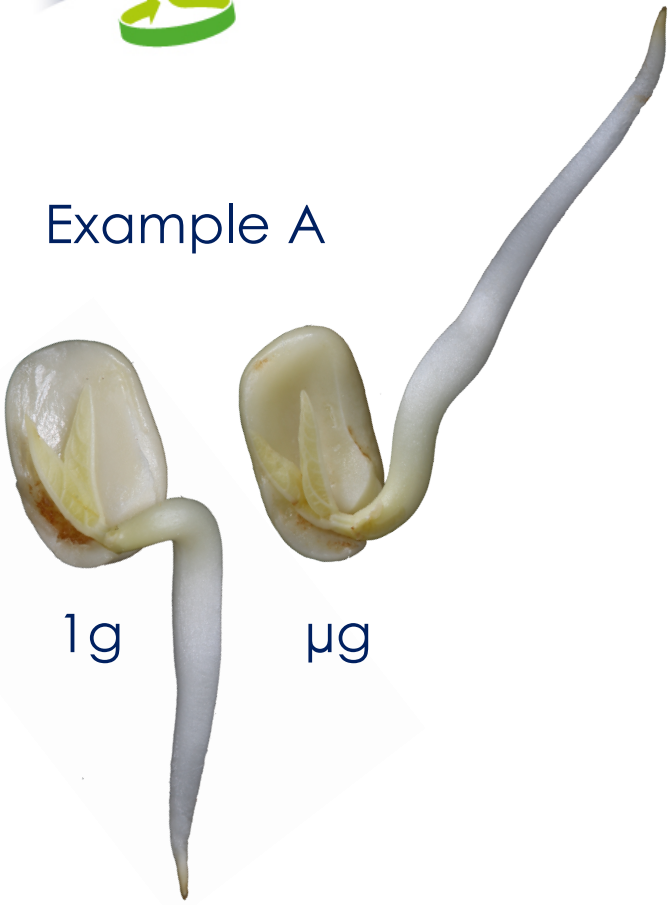
µg

Example B

1g

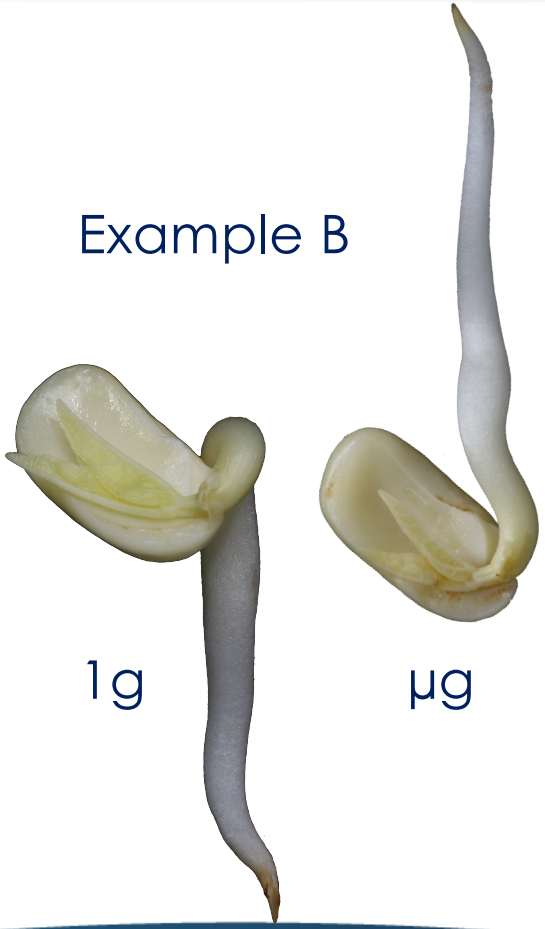
Seed orientation: possible scenarios in microgravity

Example A



1g μg

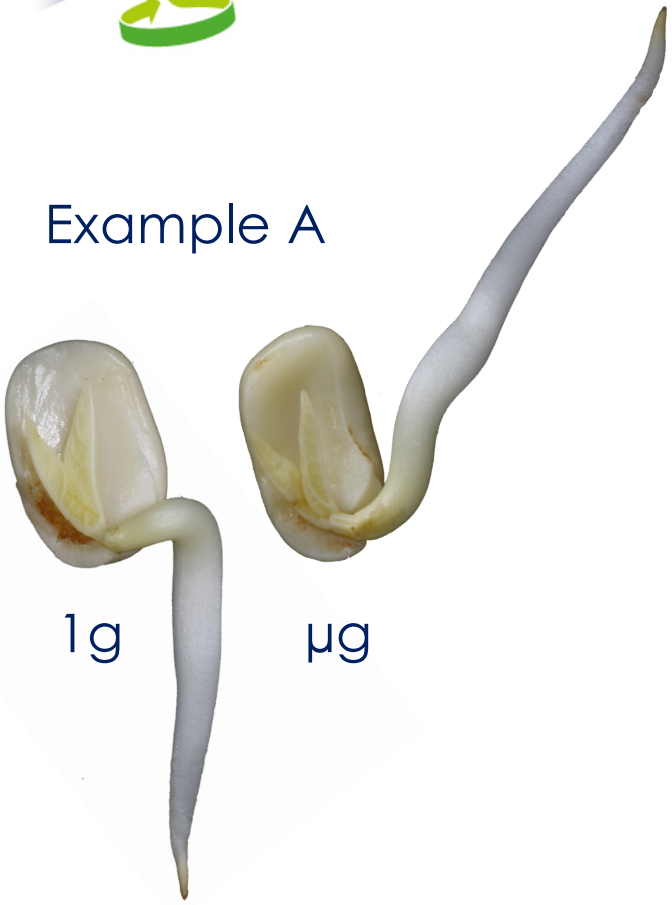
Example B



1g μg

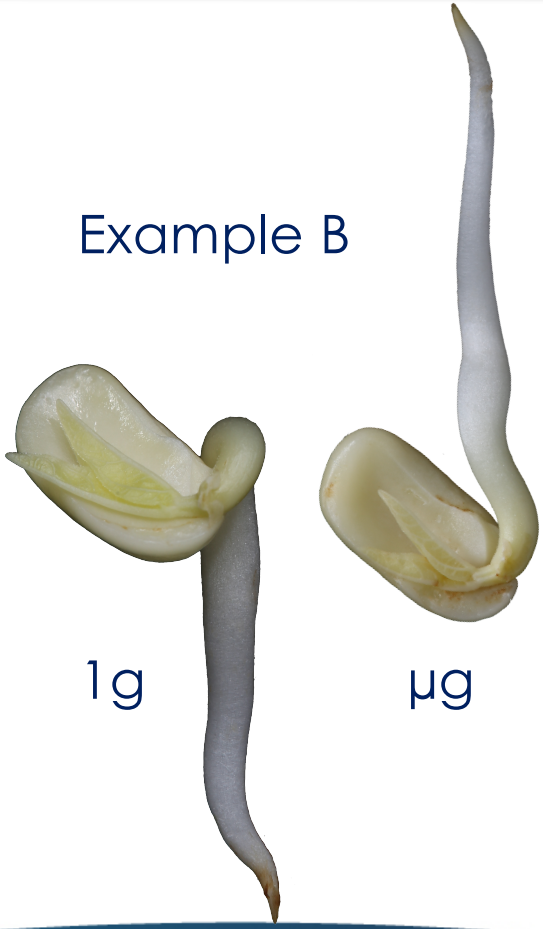
Seed orientation: possible scenarios in microgravity

Example A

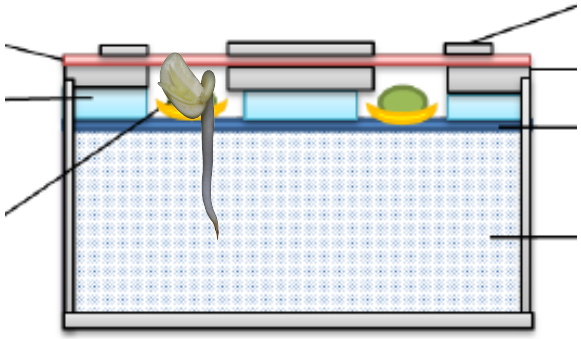


1g μg

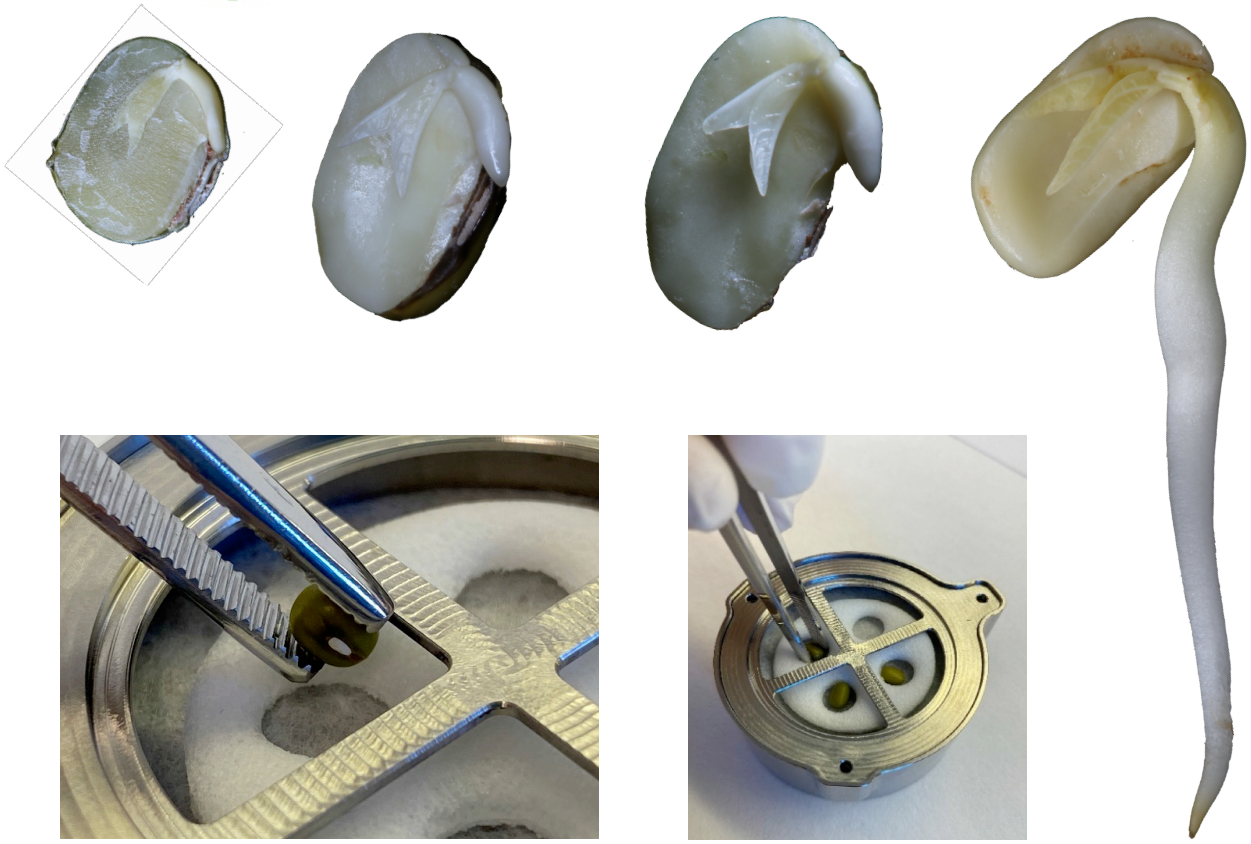
Example B



1g μg



Data usage: empirical approach

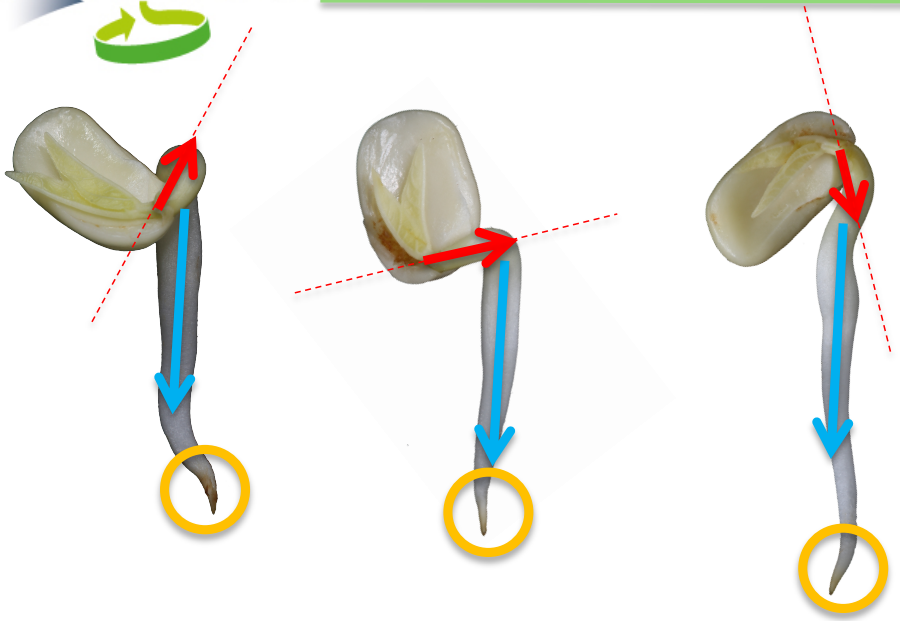


Results of the
- *Seed orientation tests*
together with those from the

- *Substrate tests*
- *Seed cover tests*
- *Gum guar tests*
- *New lid tests*
- *Hydration tests*

gradually increased percent success of seedling development up to 100% of the germinated seeds

Data usage: theoretical approach



Sequential discontinuous models, using L-Systems and Chomsky grammars, are currently evaluated for developing predictive morphological processes related to early seedling growth.

Present studies show that the L-systems rules of vegetal development must tackle with physical and physicochemical phenomena and mass balances constraints.

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THANK YOU.

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