

# SCOPE

Scientists Changing Our Pre-college Education

A stylized yellow microscope icon with blue accents, positioned to the right of the text.

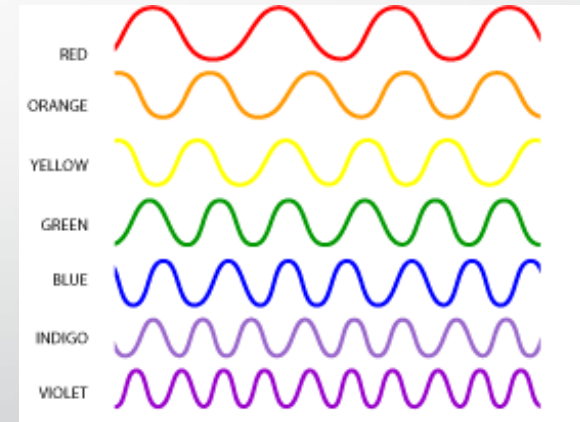
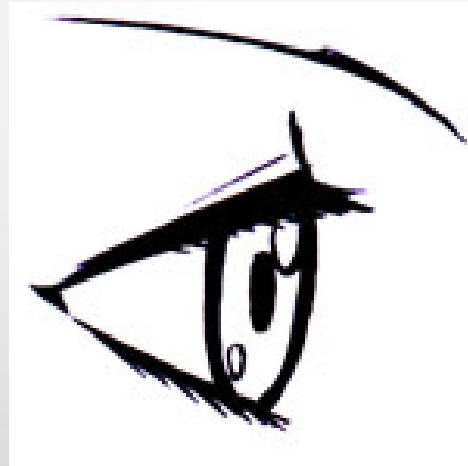
All Scanning Electron Microscope (SEM) images were taken using the Instrumentation Center's SEM at the University of Toledo.

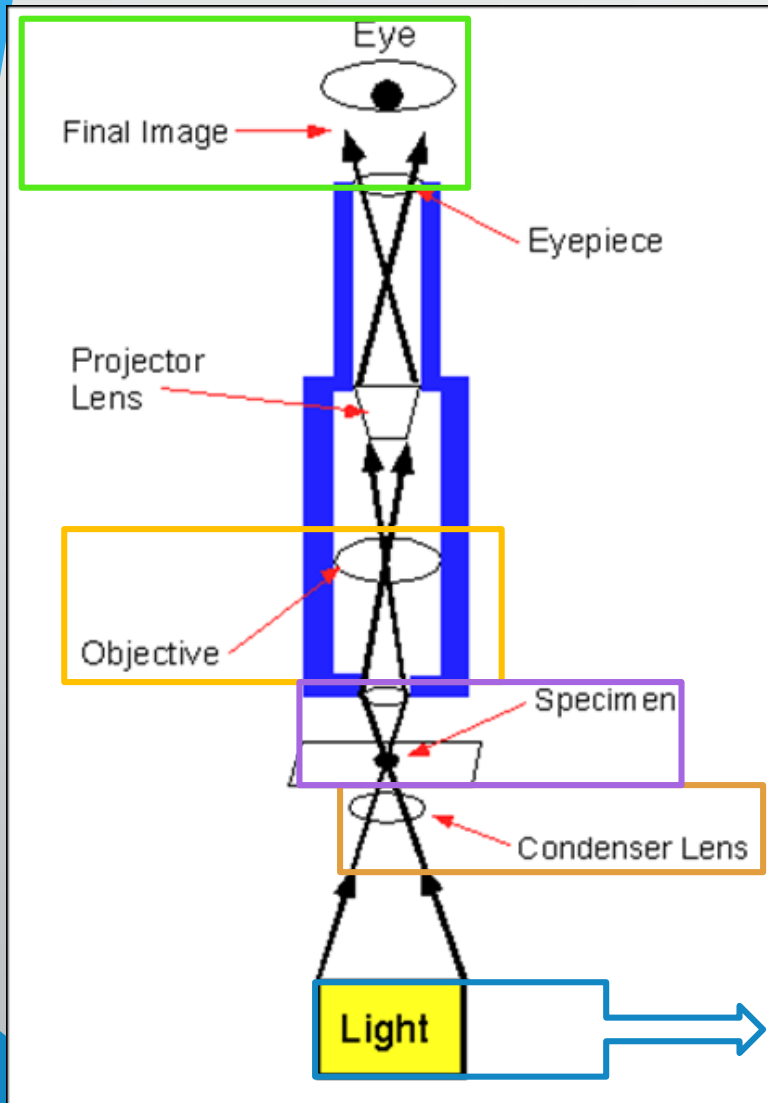
# Scanning Electron Microscope (SEM)



# Viewing Images

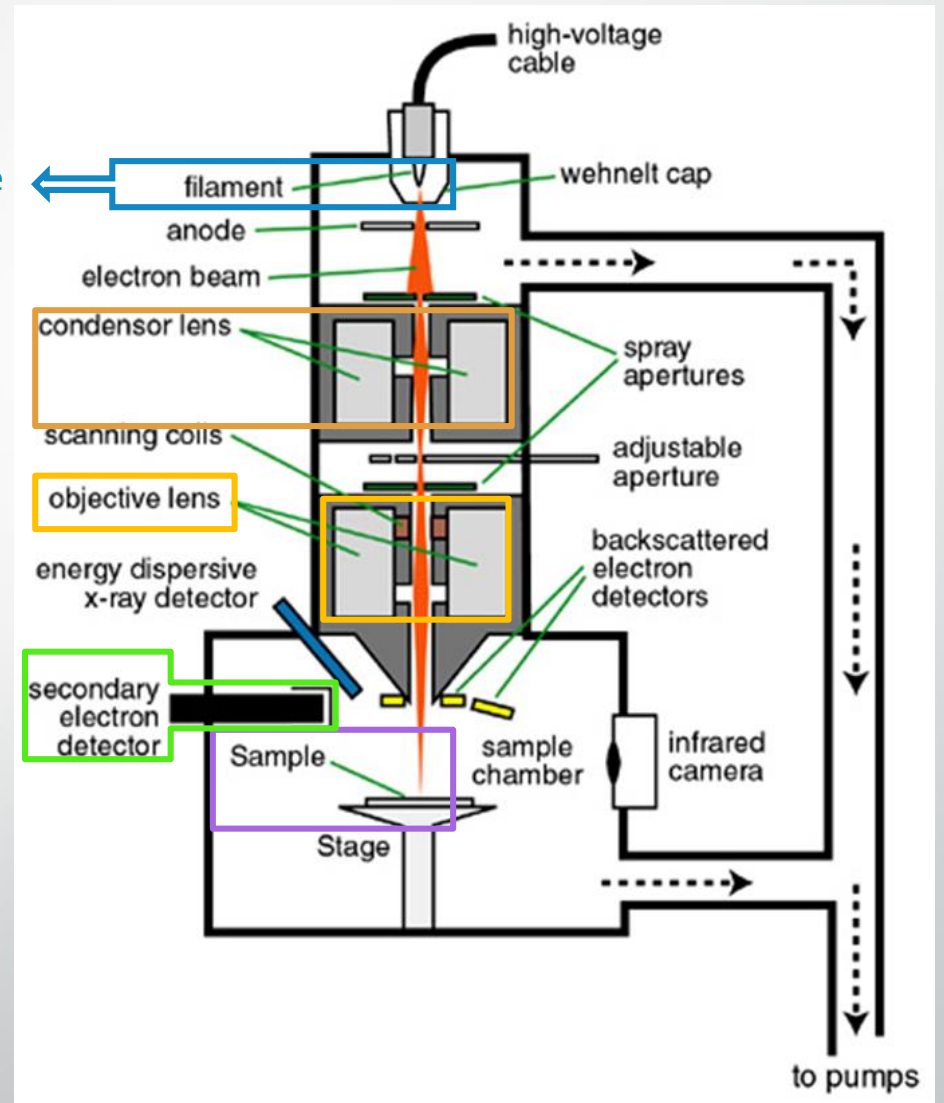
- Our eyes use light to view objects
- SEM uses electrons instead of light
- Limitations of light





Light Source

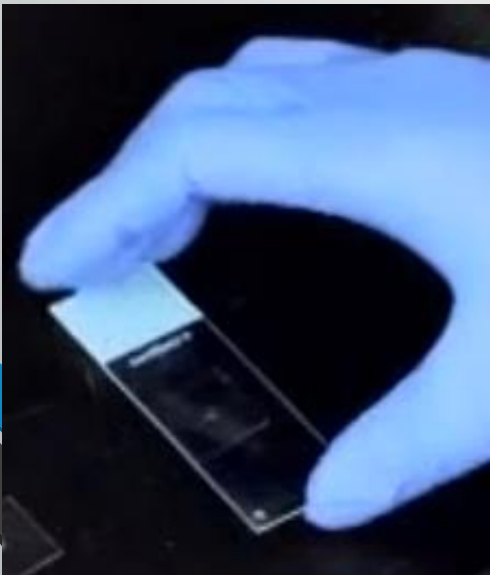
Electron Source



# Light Microscope vs. SEM Samples

## Light Microscope

- Very thin
- Glass slides
- View organelles, internal structures



## Scanning Electron Microscope

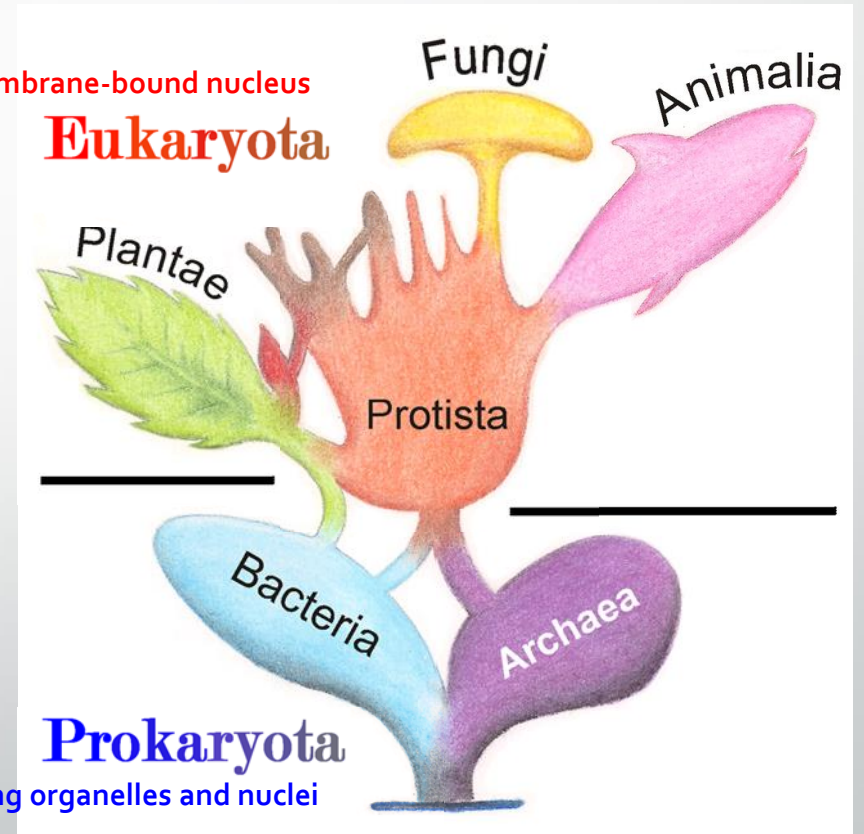
- Must be small
- Aluminum stubs
- View morphology, surface



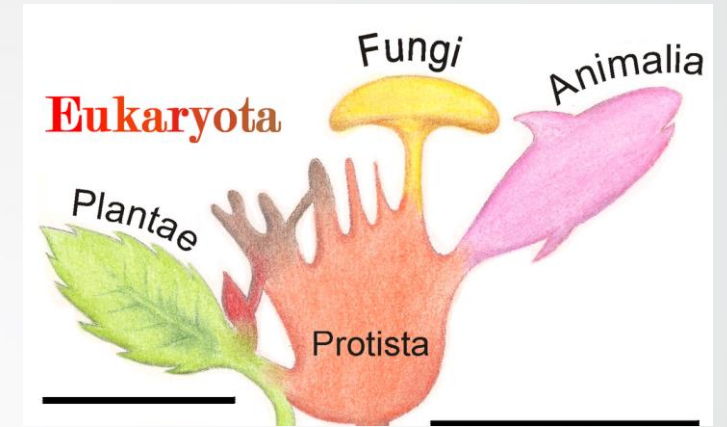
# Kingdoms of Life

- Six Kingdoms:
  - Bacteria
  - Archaea
  - Animalia
  - Fungi
  - Plantae
  - Protista/Chromista

Organisms whose cells contain a membrane-bound nucleus



# Eukaryota



Single or Multi-celled Organisms, Cell Nucleus, Membrane-bound Organelles

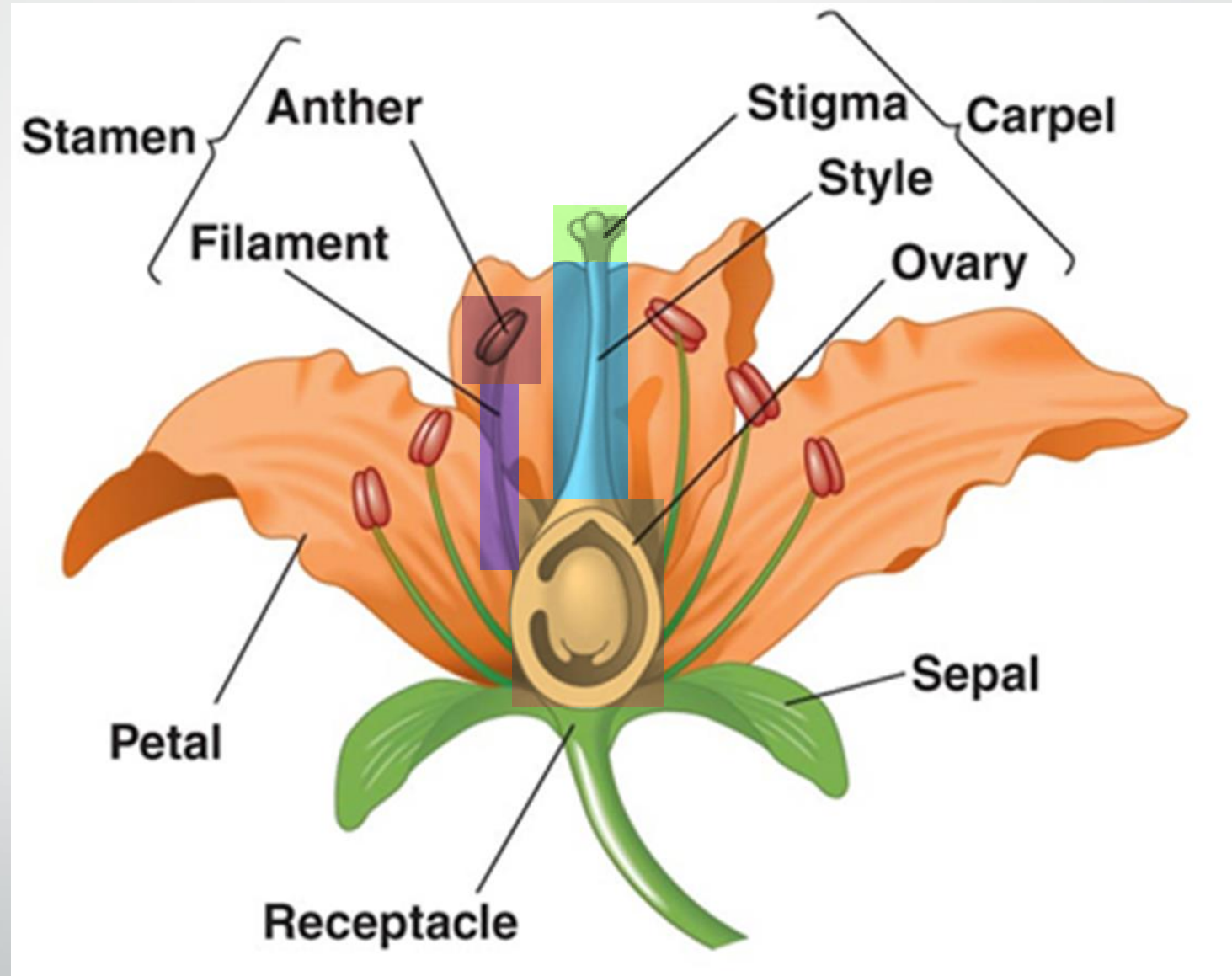
- Plantae
  - Characteristics:
    - Multicellular
    - Photosynthesis
    - Chlorophyll
    - Do not move
  - Examples: flowers, burrs, trees
- Protista/Chromista
  - Characteristics:
    - Mostly single celled
    - Usually aquatic
    - Possible movement through cilia or flagella
    - Photosynthesis in some species
  - Examples: algae, giant kelp, amoeba



# Plant Reproduction

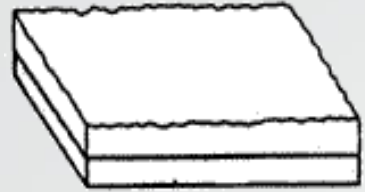
## Flowering Plants

- Female reproductive organs (Carpel)
  - Pollen is introduced to stigma
  - Travels through style
  - Reaches ovary
- Male reproductive organs (Stamen)
  - Pollen produced in anthers
  - Filaments support anthers

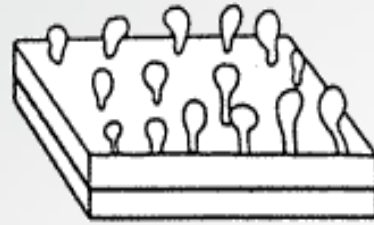




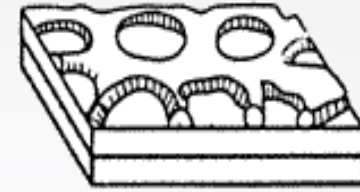
# Morphology of Pollen



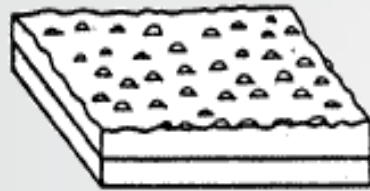
psilate



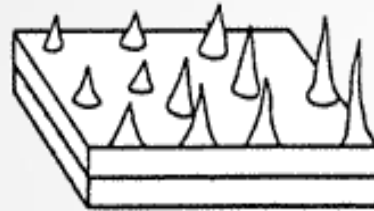
clavate



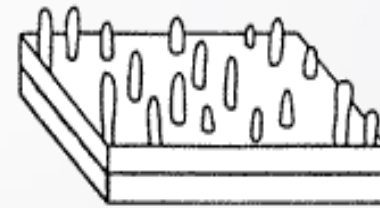
reticulate



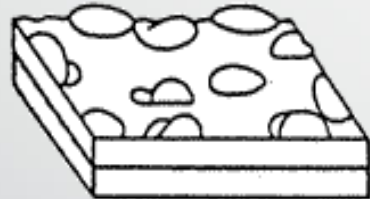
scabrate



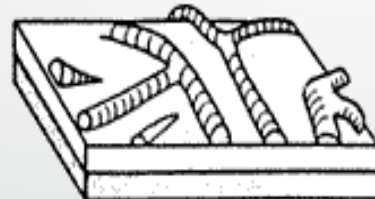
echinate



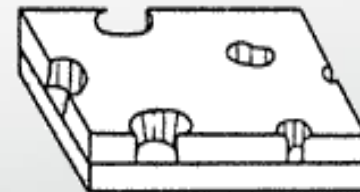
baculate



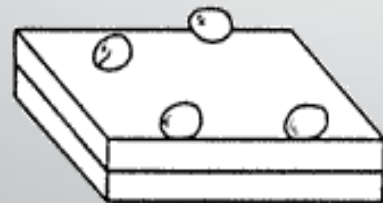
verrucate



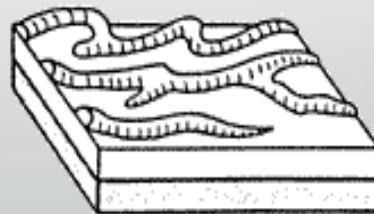
rugulate



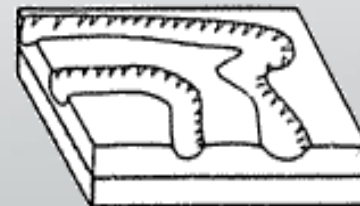
foveolate



gemmate



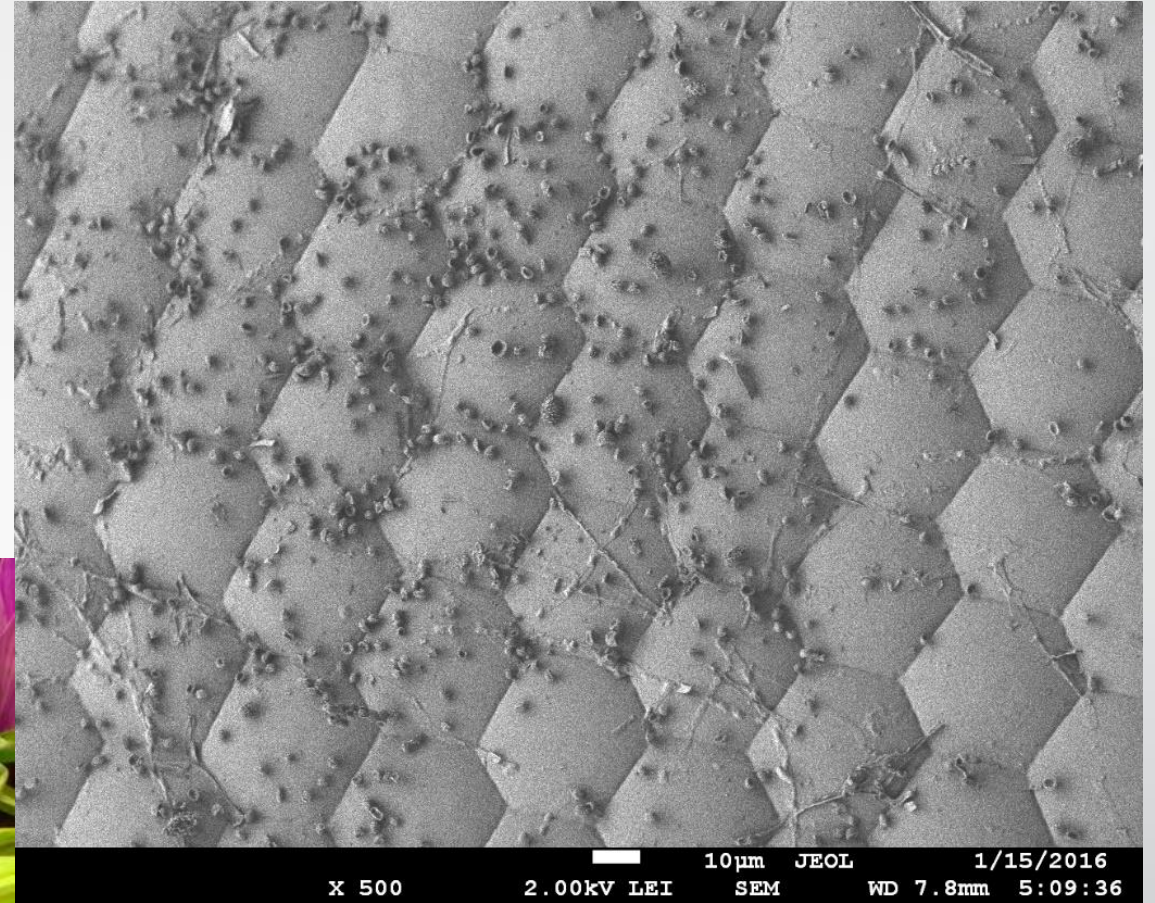
striate



frustillate

# Zoophilous

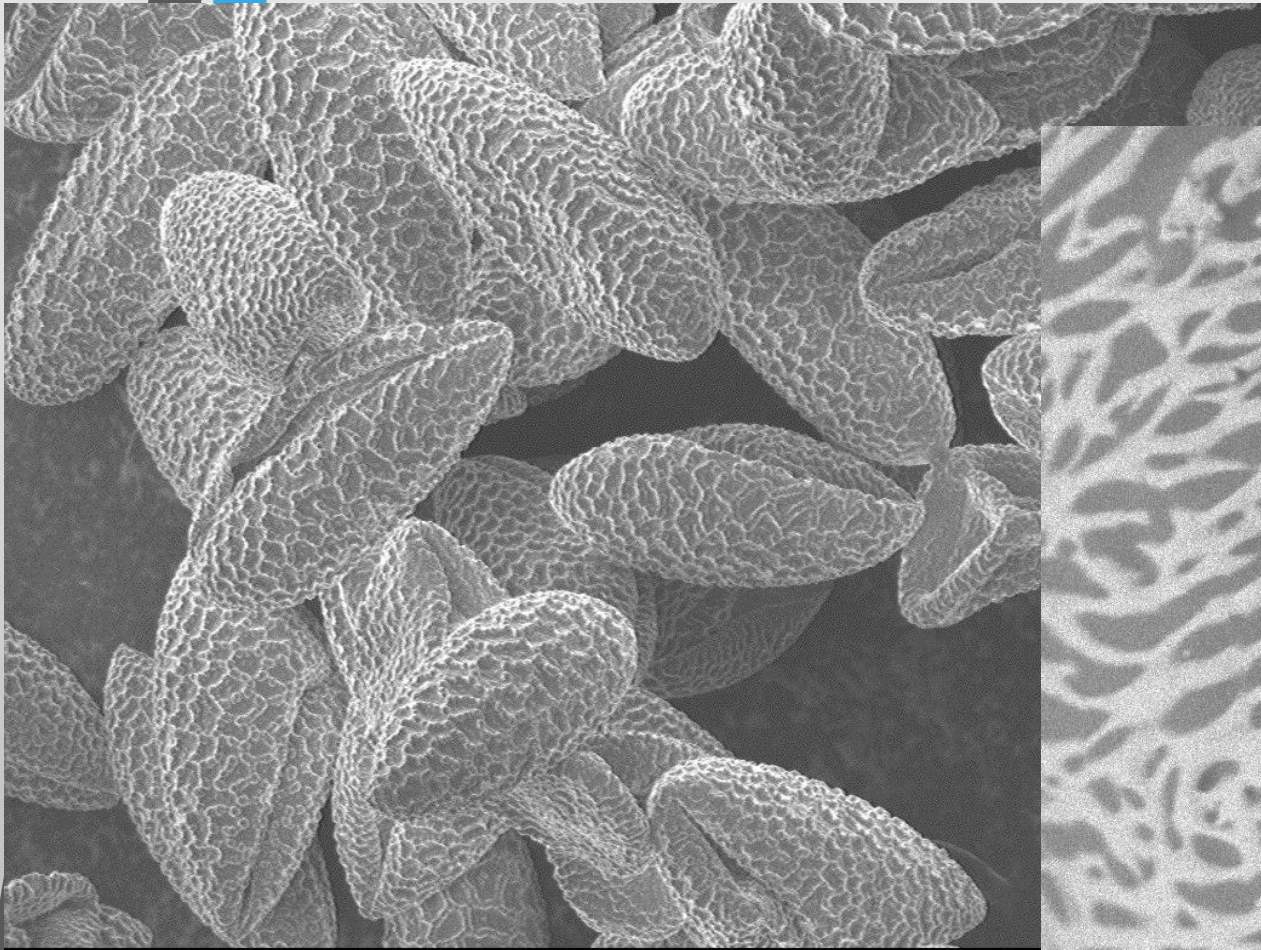
- Carried by insects or animals
- Large, colorful, strongly scented flowers
- Course pollen
- Pollenkit\*
- 80% of all plants



↗ Various pollens and mold on a Yellow Jacket eye

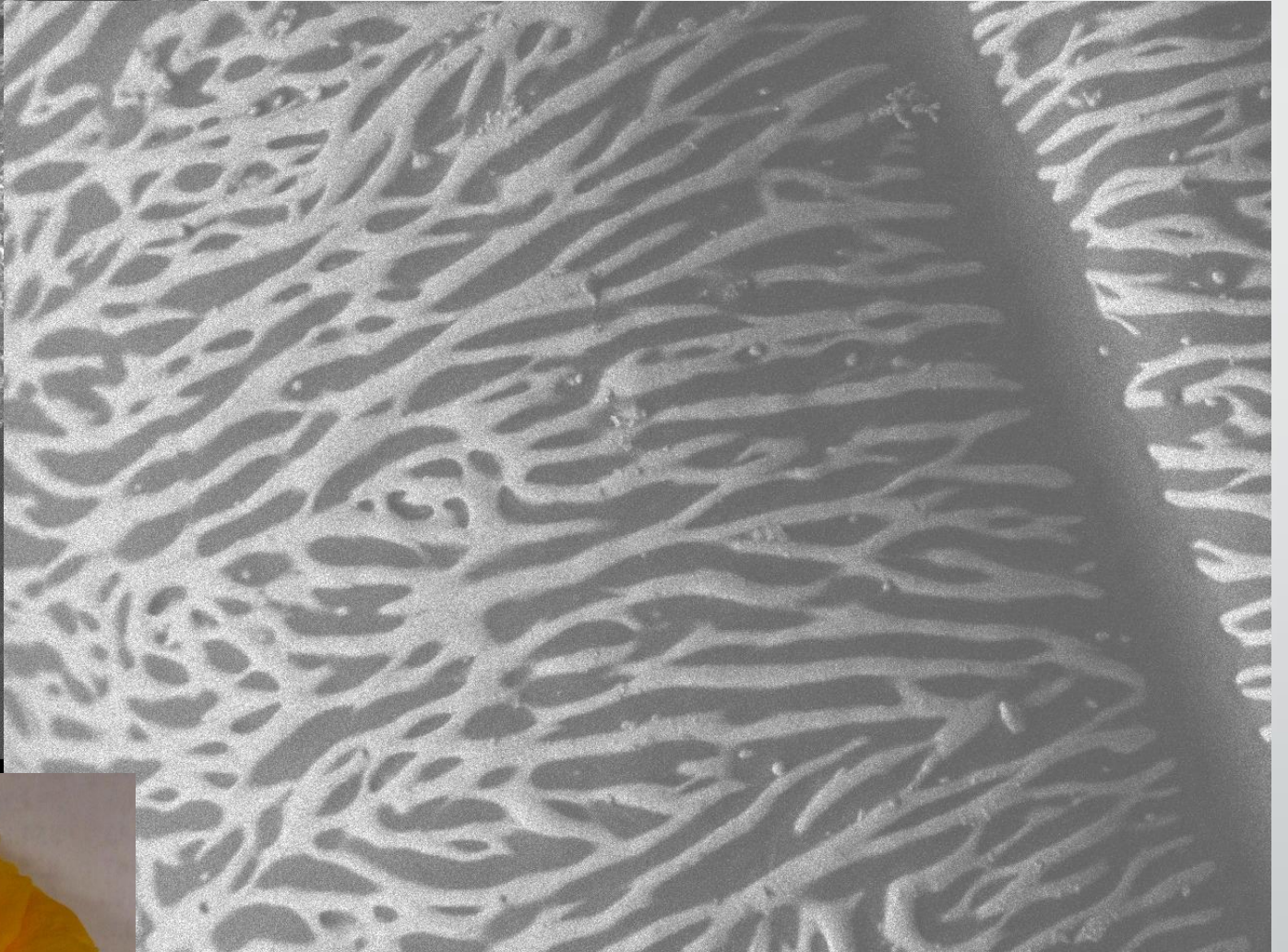
*\*Pollenkit is an oily, sticky substance found on some types of pollen that helps it stick to insects and animals*





X 330 2.00kV LEI

10µm JEOL



X 4,300

2.00kV LEI

1µm JEOL

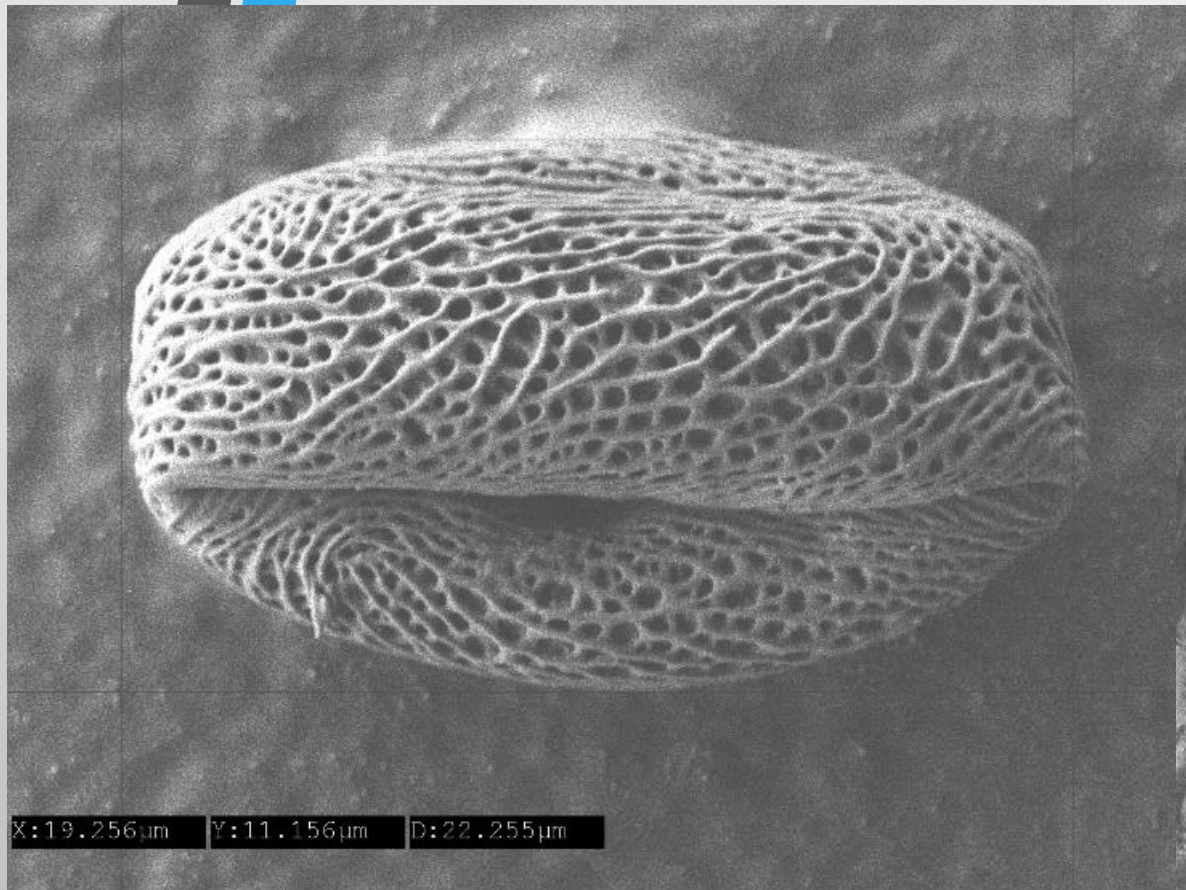
SEM

WD 9.8mm 12/8/2017 10:47:24

Lillies







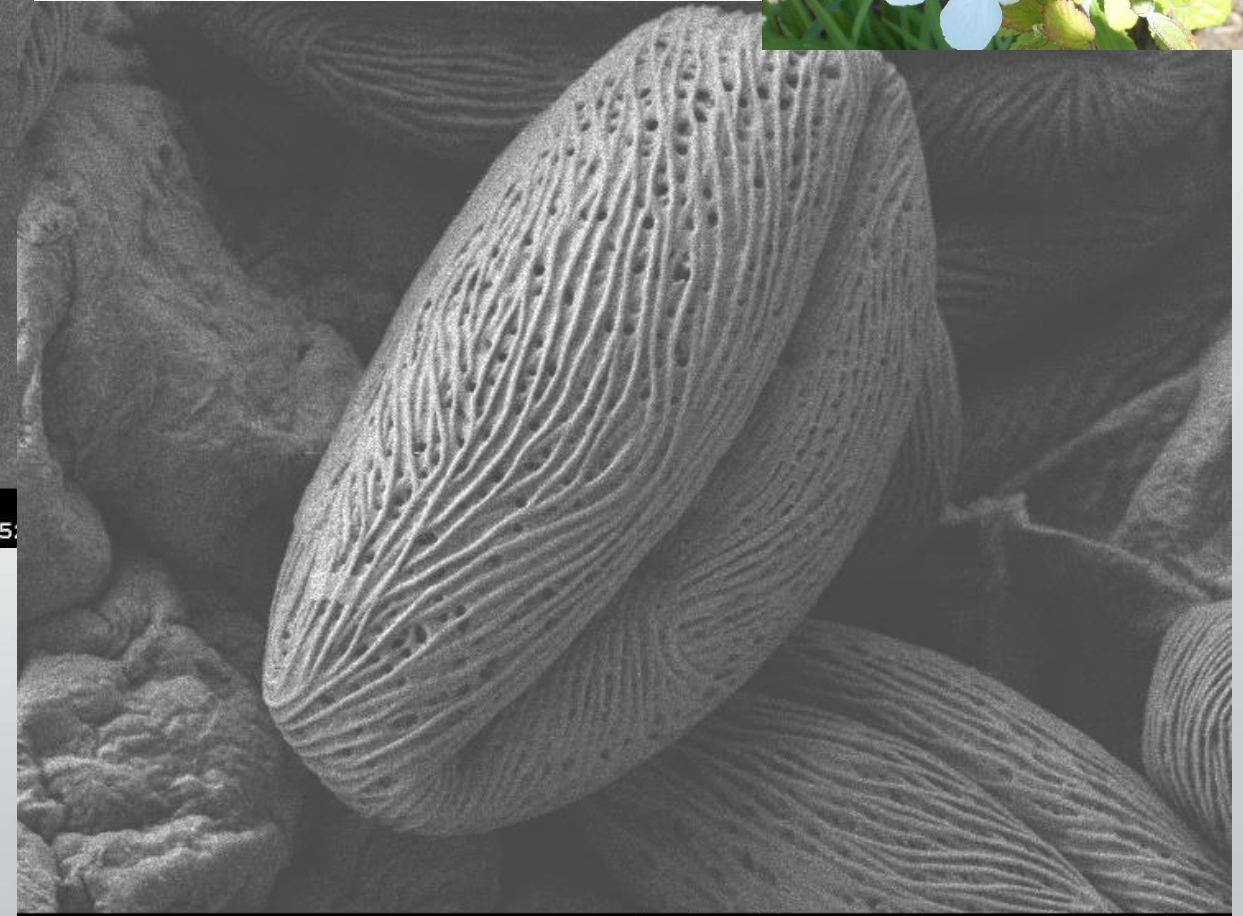
X:19.256µm Y:11.156µm D:22.255µm

1µm JEOL 6/5/2014  
20.00kV LEI SEM WD 9.4mm 12:48:50

Viburnum Snowflake



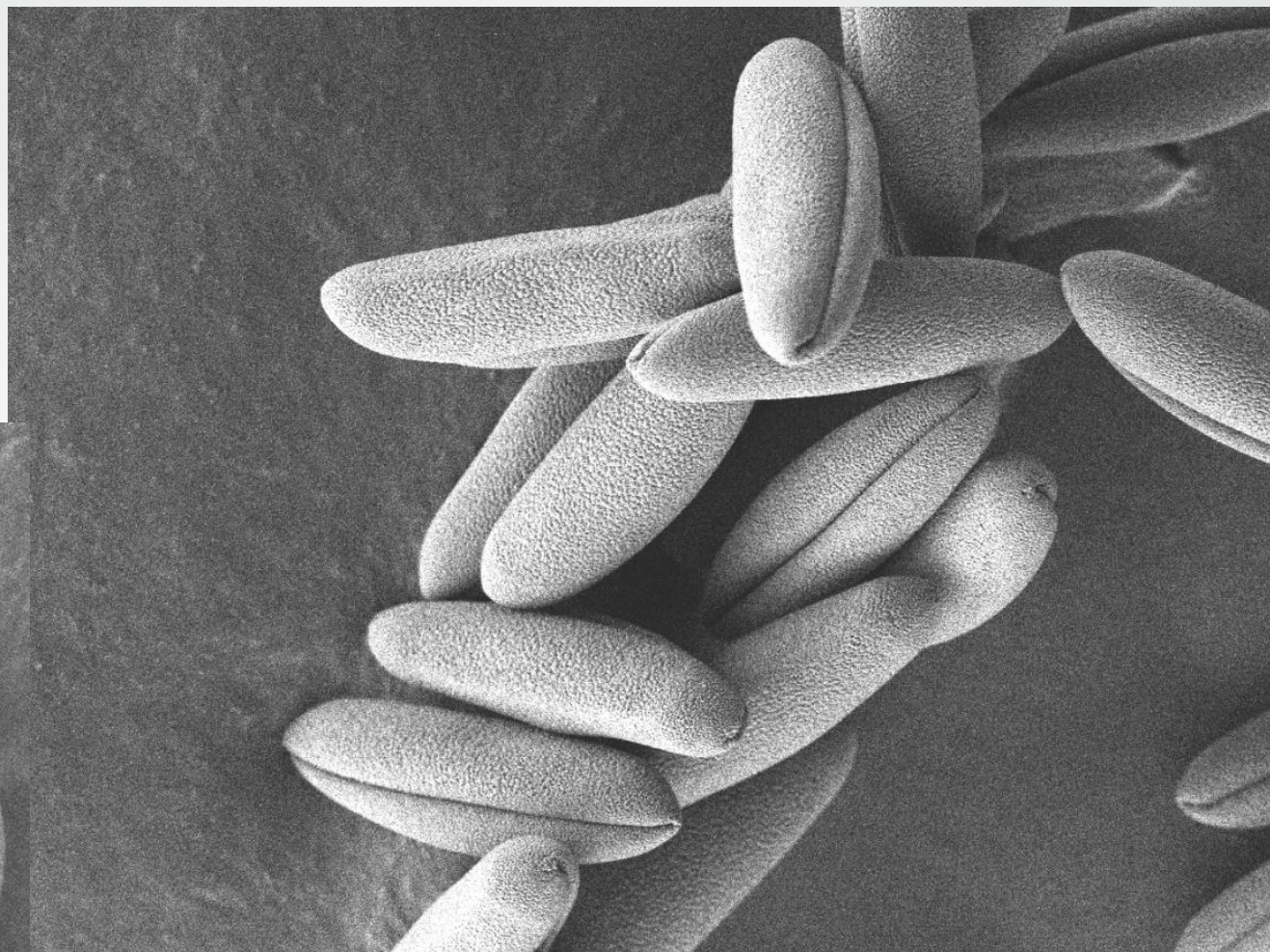
Princess Spirea



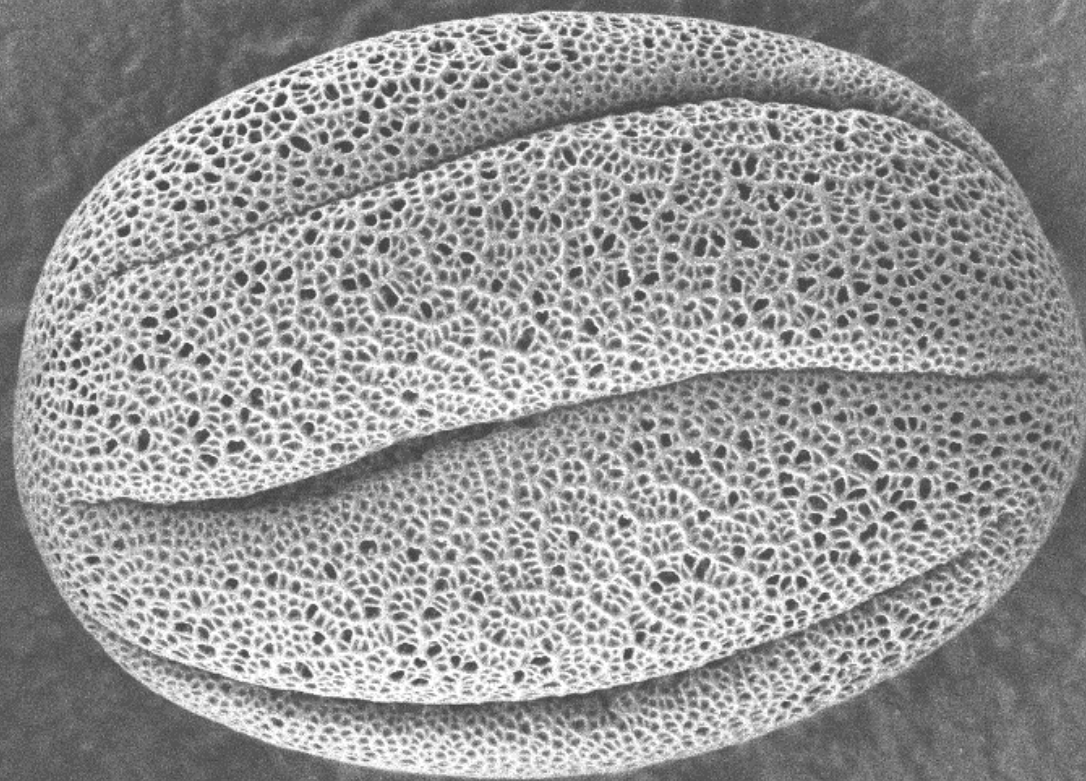
X 5,000 1µm JEOL 5/23/2014  
2.00kV LEI SEM WD 10.0mm 1:35:09



# Purple Salvia



X 800 10µm JEOL 6/5/2014  
2.00kV LEI SEM WD 9.4mm 12:04:58

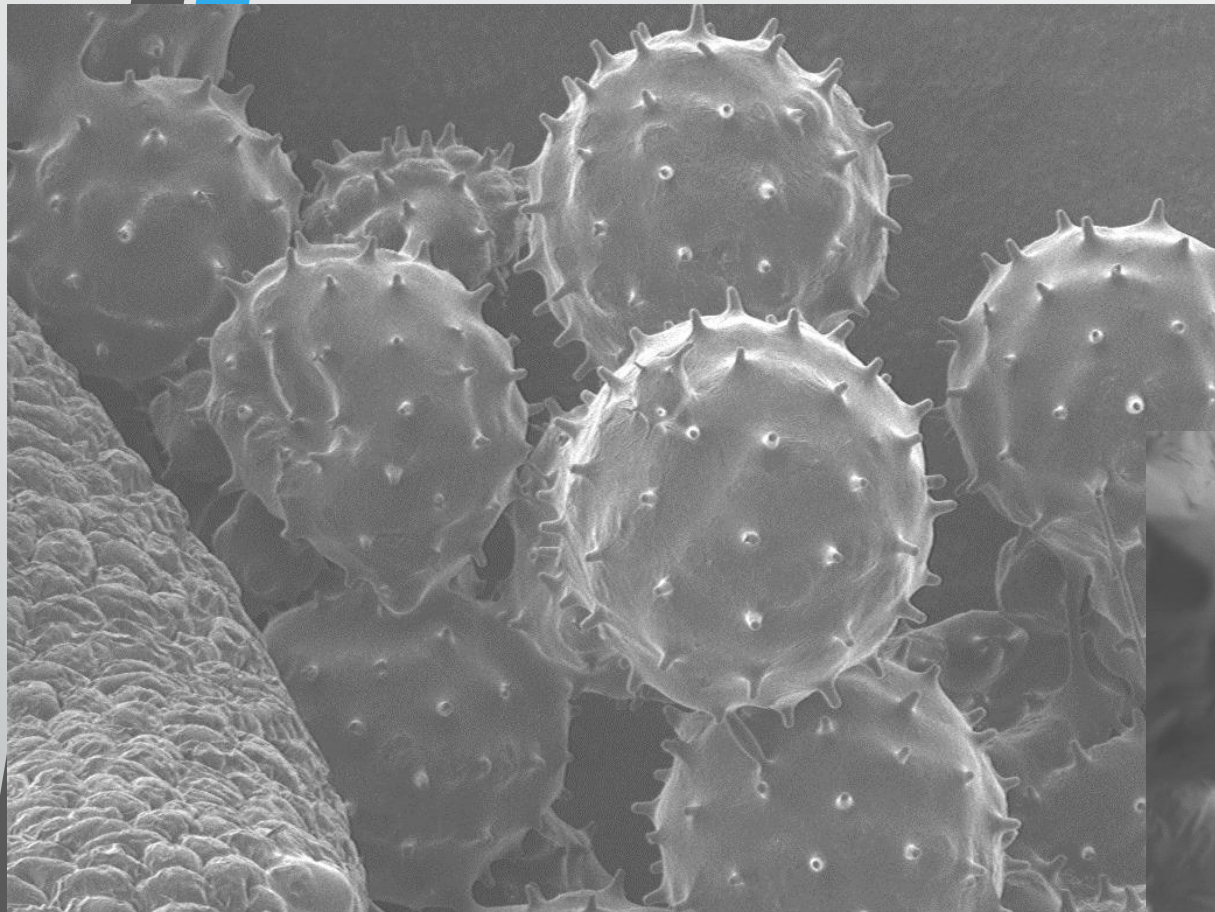


X 2,300 10µm JEOL 6/3/2014  
2.00kV LEI SEM WD 9.9mm 3:00:47

# Spiderwort



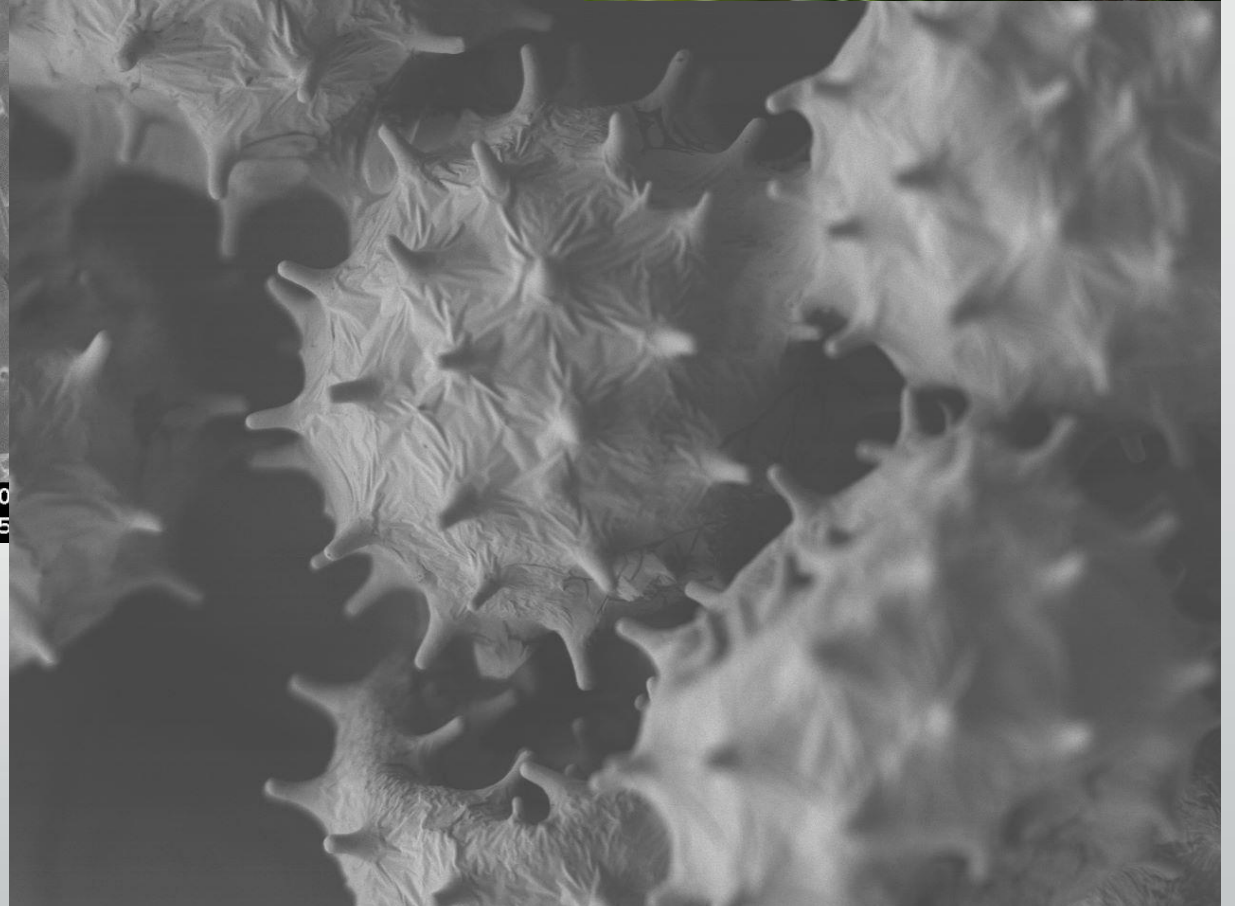




Rose of Sharon



100µm JEOL 5/15/20  
X 250 2.00kV LEI LM WD 10.0mm 1:35

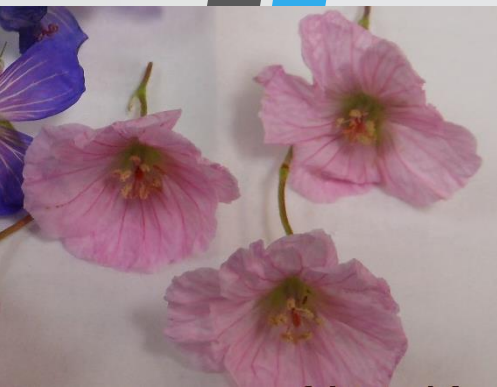


Hibiscus

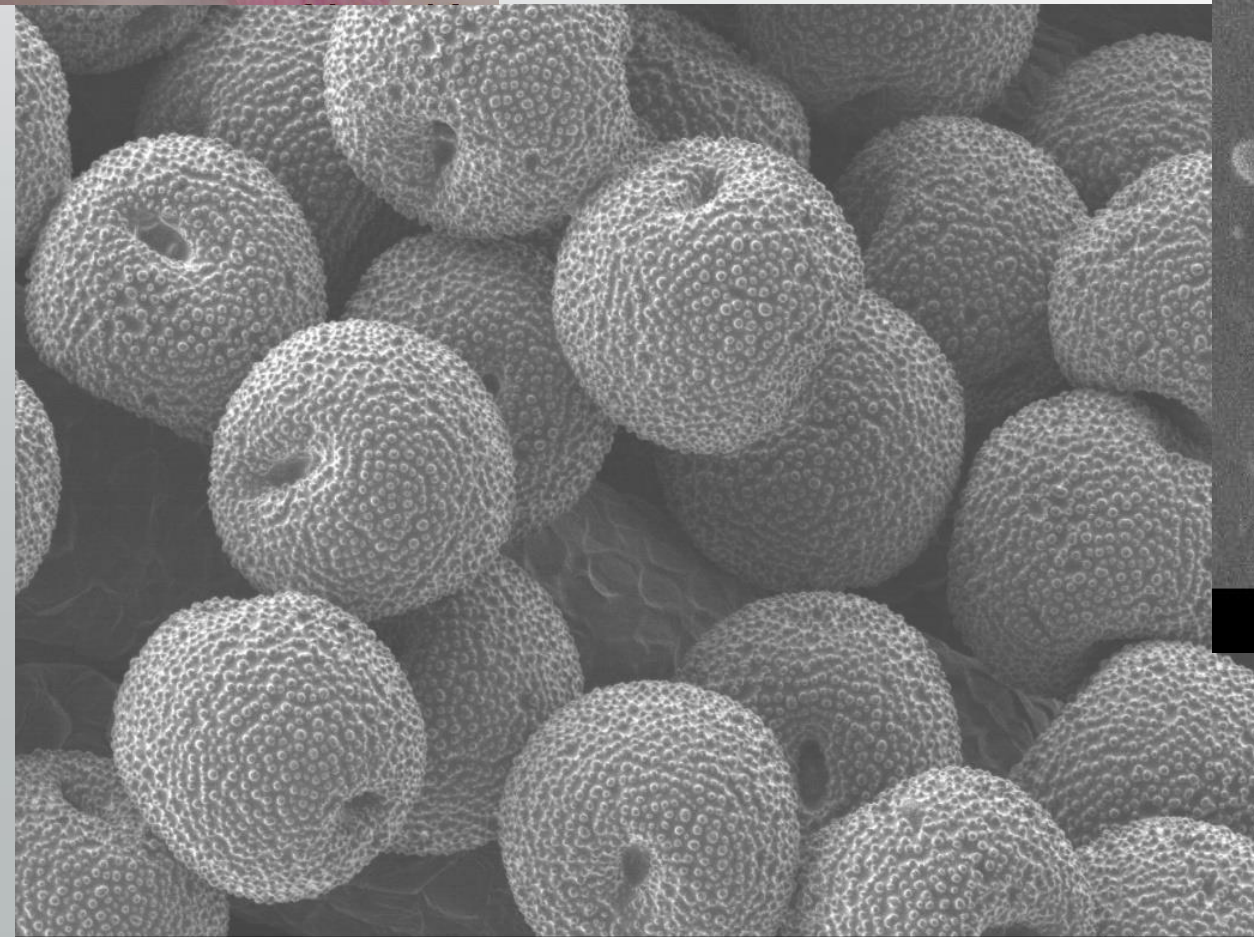


10µm JEOL 9/20/2017  
X 430 2.00kV LEI SEM WD 9.7mm 12:32:02

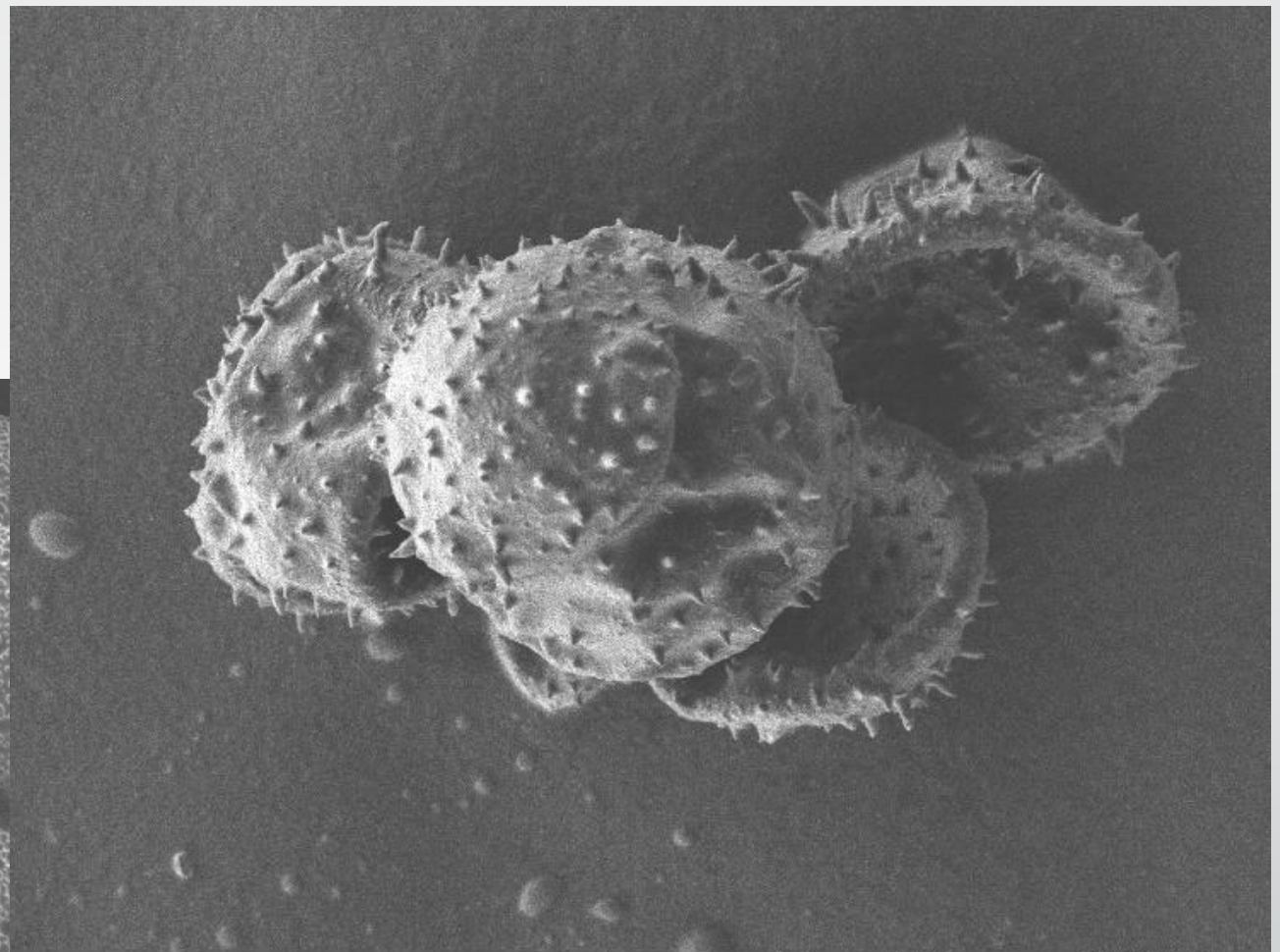




Pink Cranesbill  
Geranium



X 300 10µm JEOL 6/5/2014  
2.00kV LEI LM WD 10.0mm 1:23:20

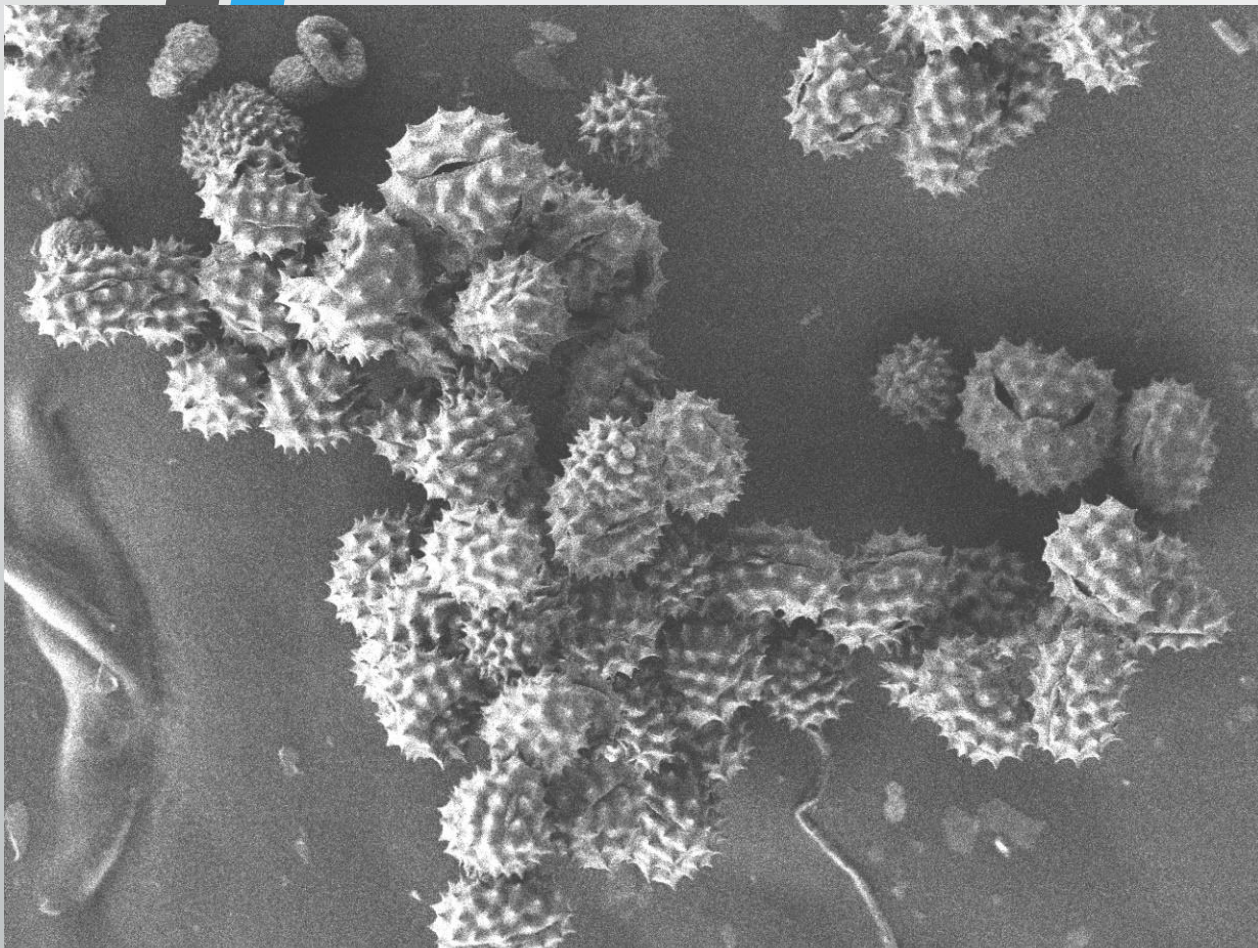


X 950 10µm JEOL 6/6/2014  
2.00kV LEI SEM WD 10.0mm 12:00:11

Weigela





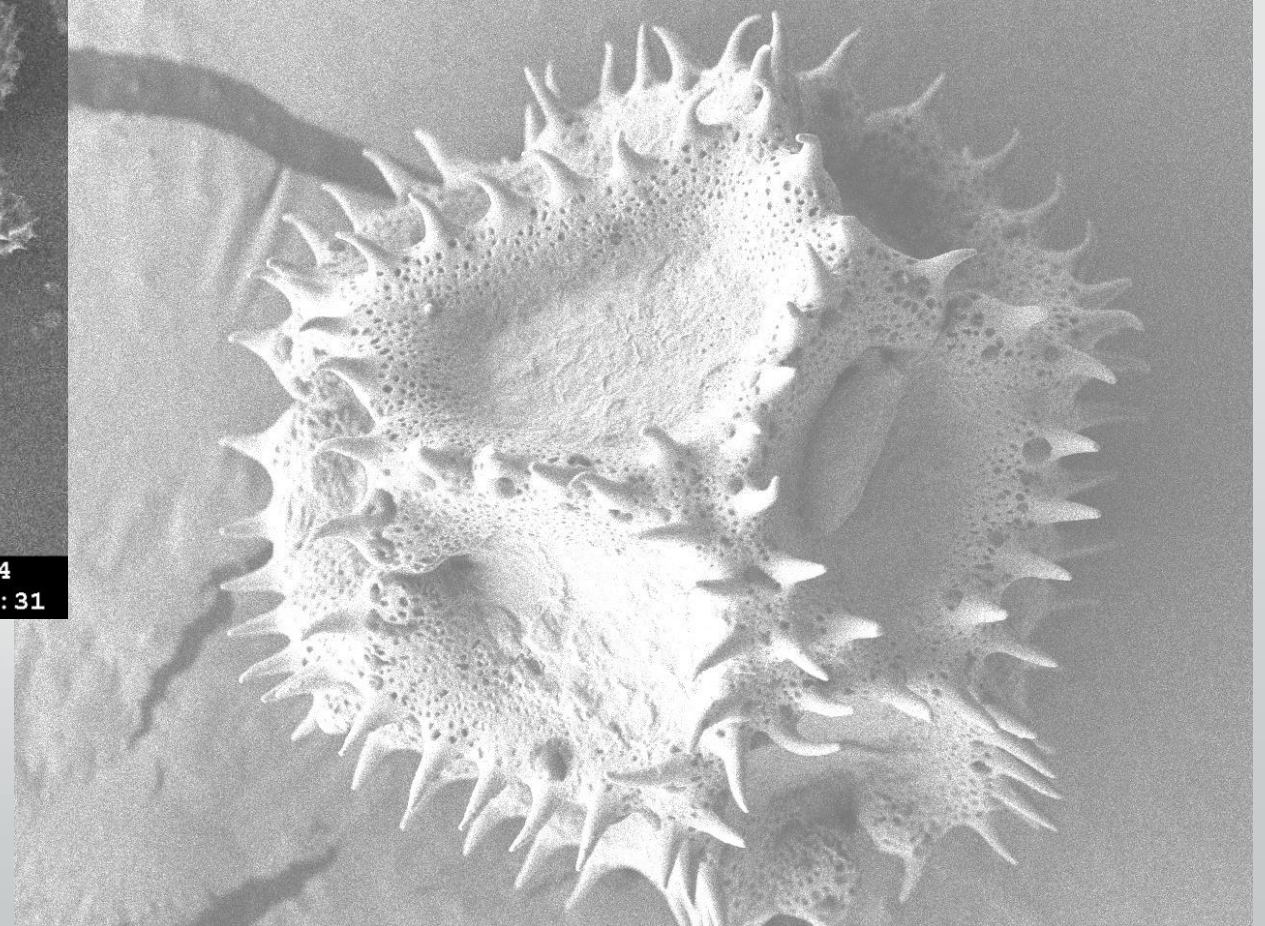


X 400 10µm JEOL 6/9/2014  
2.00kV LEI SEM WD 9.6mm 1:00:31

Chicory



Yarrow



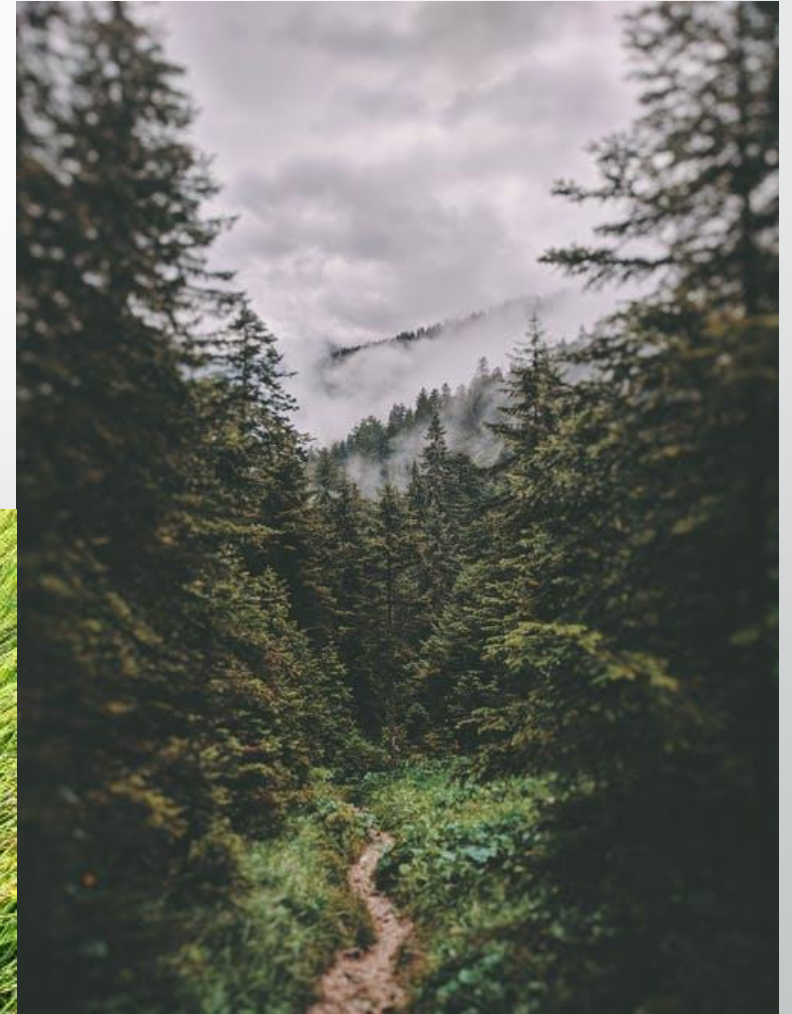
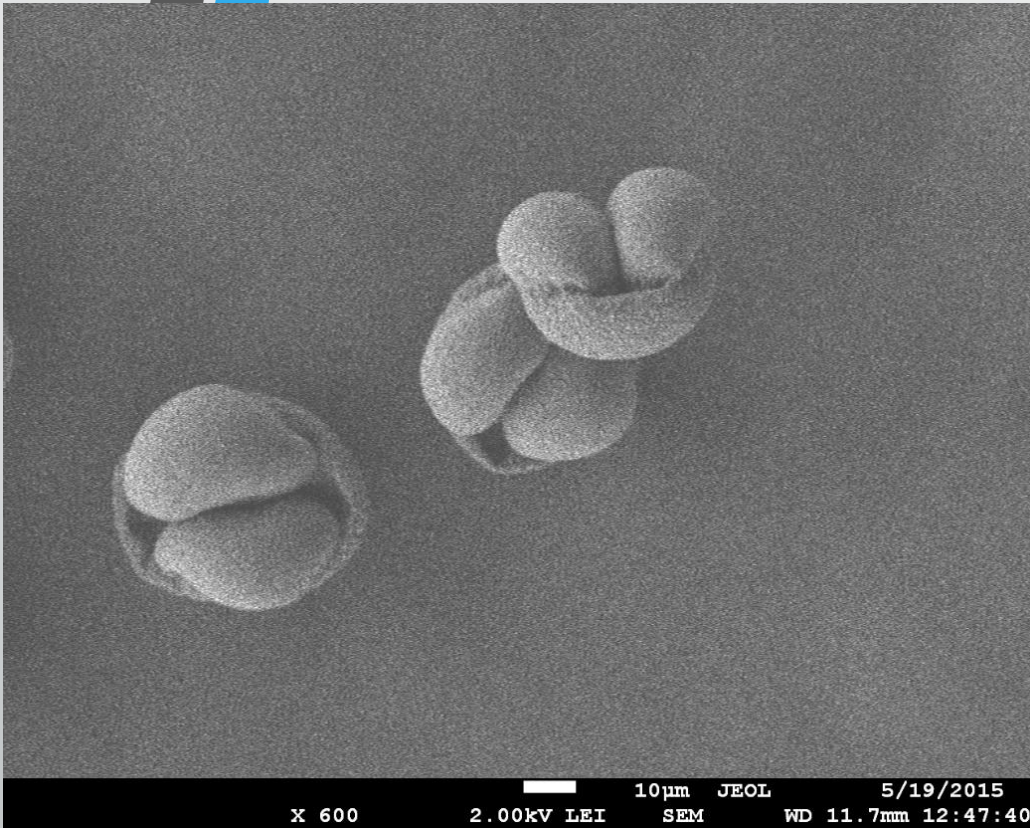
X 2,300 10µm JEOL 10/25/2017  
2.00kV LEI SEM WD 9.9mm 1:40:58



# Anemophilous

- Wind carries pollen – pollination by chance
- Trees, grasses
- Smooth pollen
- No pollenkit
- Causes Hay Fever

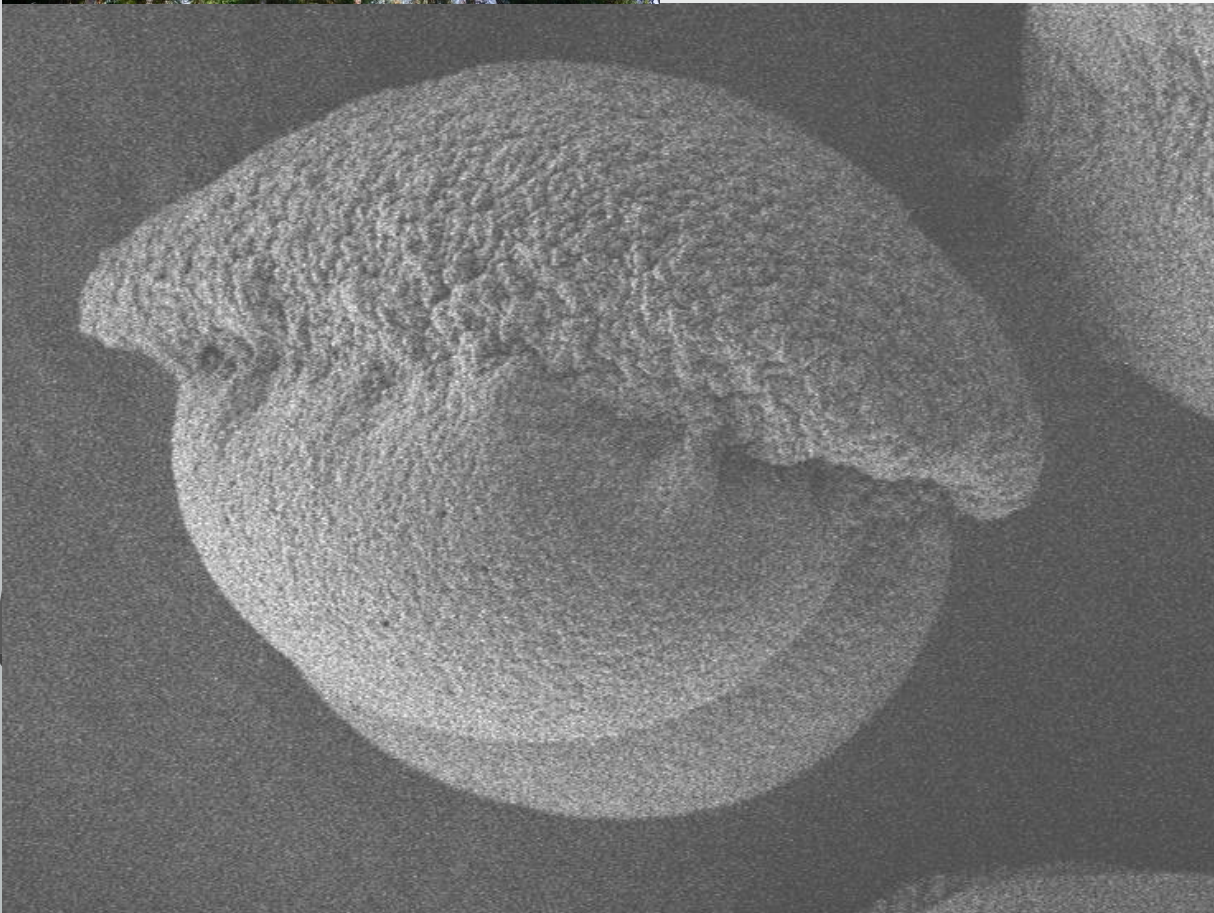
← Pine tree pollen



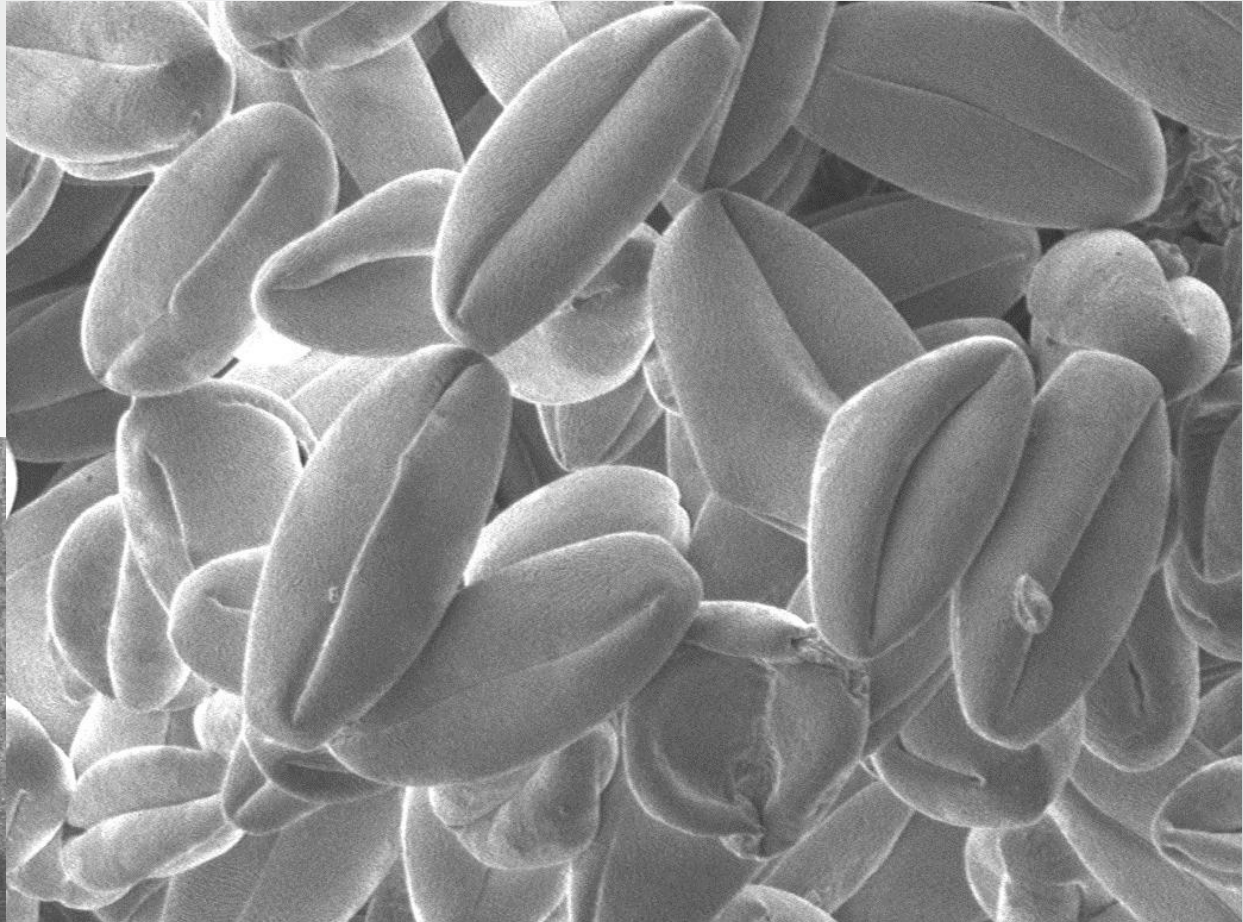




Pine Tree



X 2,000 10µm JEOL 5/19/2015 2.00kV LEI SEM WD 11.7mm 12:53:09

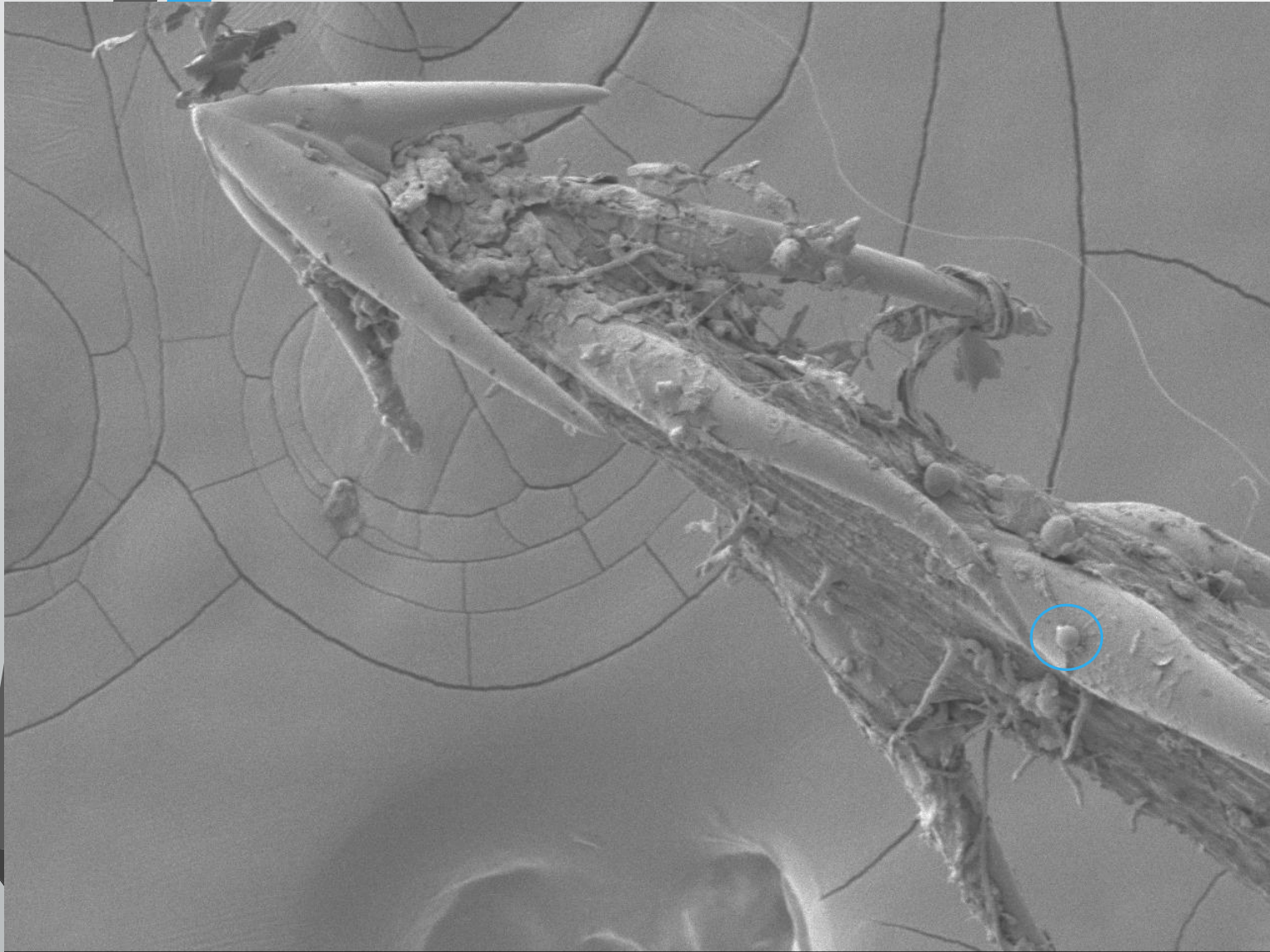


X 900 10µm JEOL 5/15/2013 2.00kV LEI LM WD 10.0mm 1:51:57

Cherry Tree







X 200 100µm JEOL 11/13/2017  
2.00kV LEI LM WD 10.0mm 1:18:21



Beggar's Lice







<https://www.homestratosphere.com/wp-content/uploads/2019/07/Red-Columbine.webp>

What type of locomotion does this pollen use?

Zoophilous

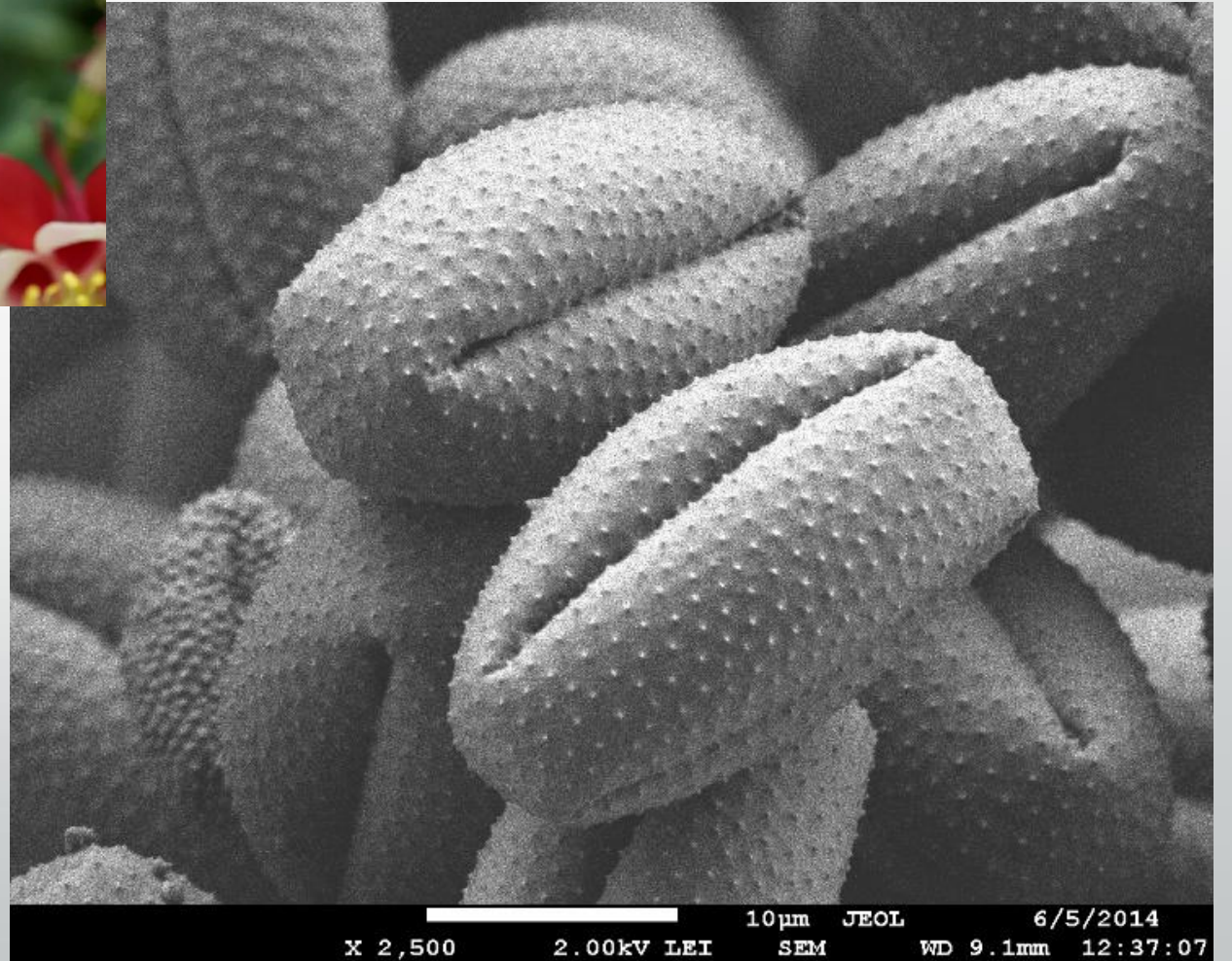
Is there likely pollenkit on this pollen?

Yes

Is this pollen likely to cause hay fever?

No, it probably has pollenkit and is carried by insects or animals

## Columbine Flower







Is this pollen zoophilous or anemophilous?

Zoophilous, it has a coarse texture

What kind of morphology does this pollen have?

Striate

Is this from a flower or grass?

Flower because the pollen is coarse and probably has pollenkit.



Hydrangea