
Leaves
LEARN AT CHESTER ZOO

Palm leaves on trees (Indonesia) and sampled from a young plant

Using light and S.E. Microscopy to learn more about their structure and function

- An oil palm is a large, monocotyledonous plant.
- The cotyledon is an embryonic leaf in a seed that is the first to emerge when it germinates. Monocot seeds have one cotyledon while dicotyledons, or dicots, have two. Other examples of monocots are wheat, corn, rice, grasses, bananas, sugarcane, palms, pineapples, orchids, and lilies.
- Monocots and dicots are two types of angiosperm plants which reproduce using seeds and fruits.

Tropical rainforests and oil palm plants

- Hot and humid weather with high rainfall throughout the year characterize the climate of a tropical rainforest.
- Plants need to be adapted to live in these environments
- Many tropical rainforest leaves (inc. palm oil) have a ‘drip tip’. It is thought that these drip tips enable rain drops to run off quickly.
- Plants need to shed water to avoid growth of fungus and bacteria in the warm, wet tropical rainforest.
- In drier, temperate deciduous forests a thick bark helps to limit moisture evaporation from the tree’s trunk. Since this is not a concern in the high humidity of tropical rainforests, most trees have a thin, smooth bark. The smoothness of the bark may also make it difficult for other plants to grow on their surface.
- Palm oil does not do well in competition with other plants and so plantations are exclusively oil palm.

Leaf Cross-Section Made And Examined Under Light Microscope

Hand-sectioned across the leaf using domestic razor blade

Label The Cells

Upper Epidermis

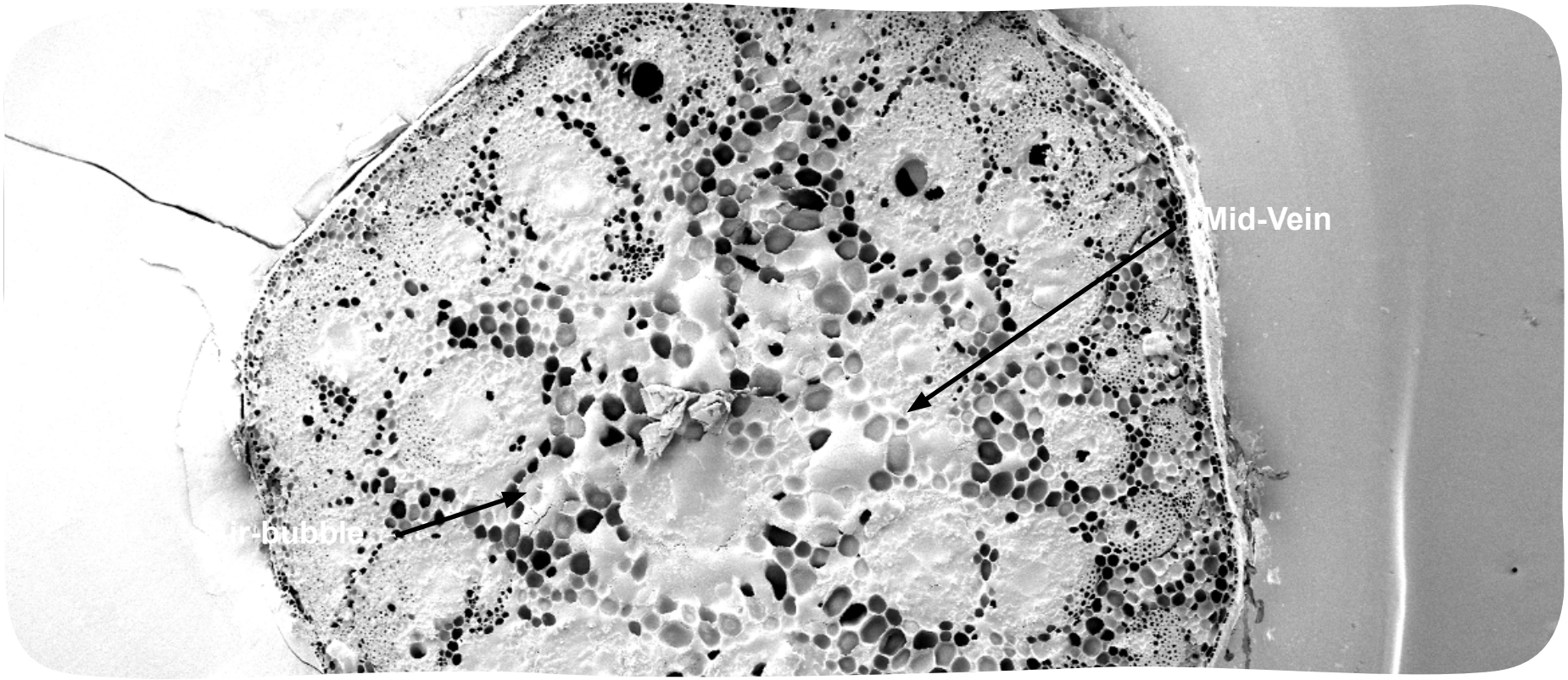
Lower Epidermis

Mesophyll

Cuticle

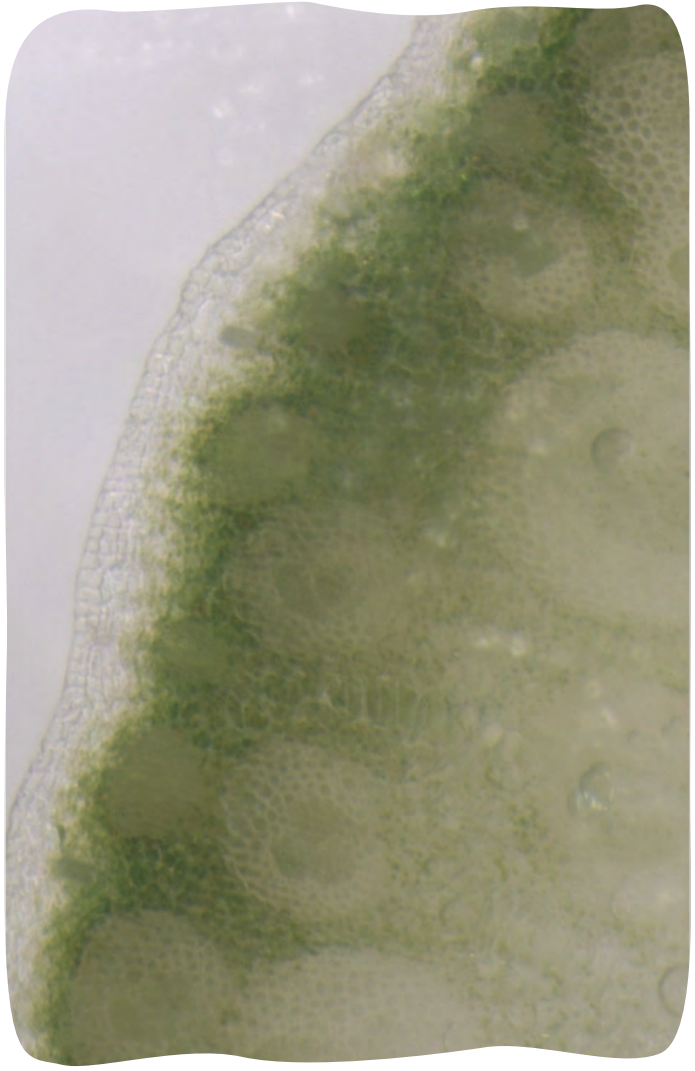
Mid-Vein

The Mid-Vein

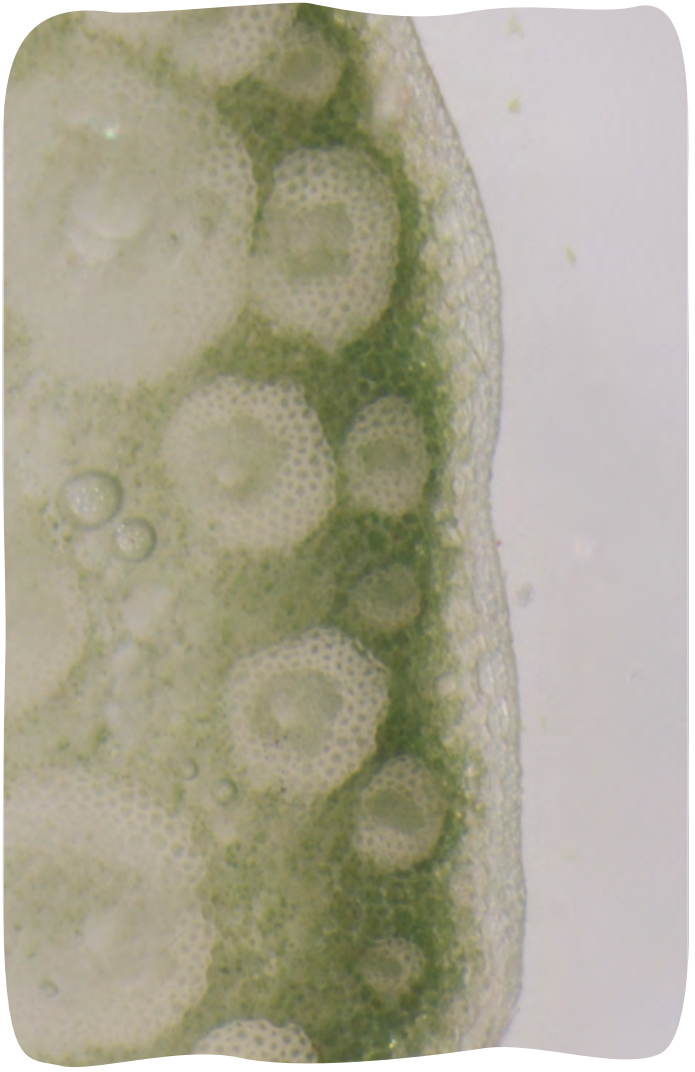


Veins are not hollow –cells inside the vein are clearly visible. The mid vein is the largest vein and contain xylem and phloem cells together with other cells. Epidermis around the vein is thicker.

Vascular Bundles (Light Microscope)

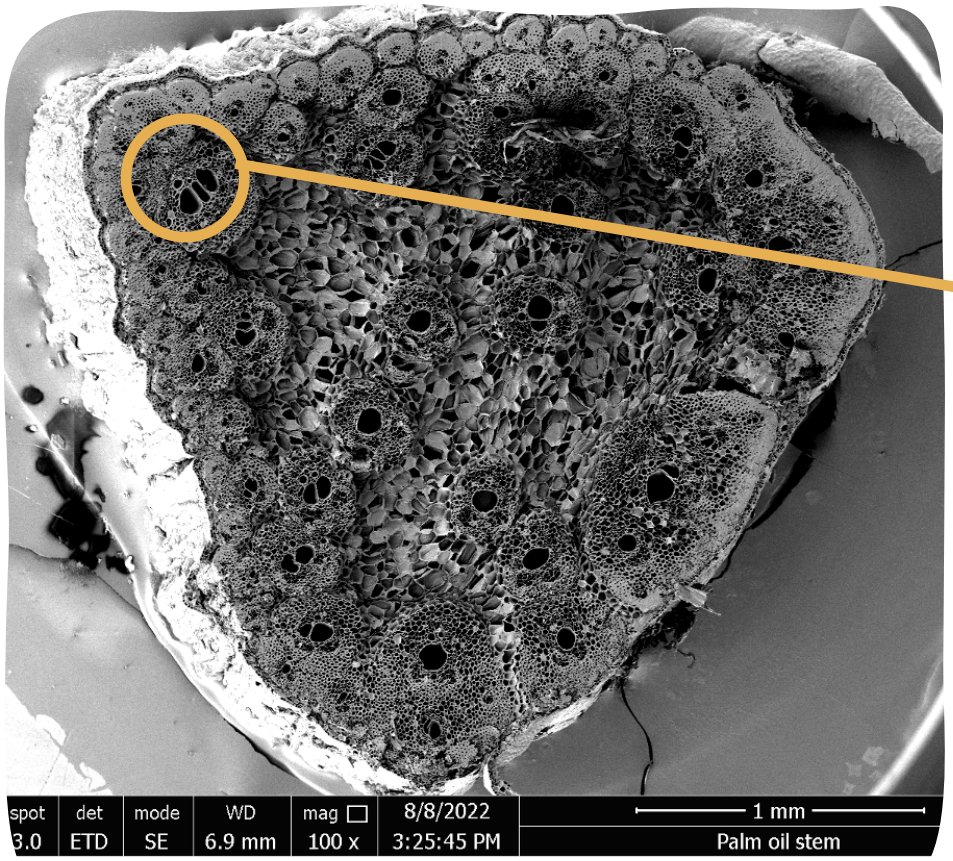


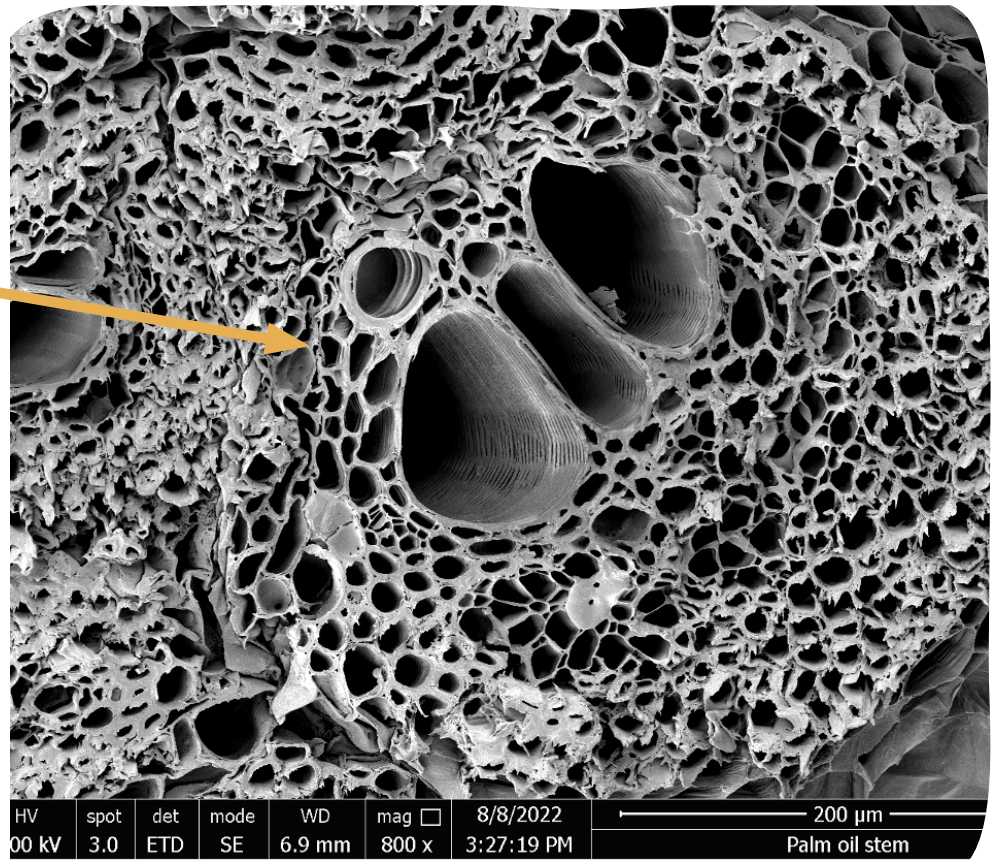
- Epidermal tissues (containing no chloroplasts and therefore no chlorophyl) are seen on the edges
- Vascular bundles are scattered randomly throughout ground tissue which does contain chlorophyll (green pigment)
- Vascular bundles themselves lack chlorophyll with a collection of different sized cells



Epidermal tissue (upper)	Thin & transparent	Allows more sunlight to reach cells below
Palisade Mesophyll	Contains lots of chloroplasts, near the upper part of the leaf	Absorbs sunlight and is the main site of photosynthesis in the leaf
Spongy Mesophyll	Irregularly shaped and contains many air spaces	Increased surface area for gaseous exchange
Epidermal tissue (lower)	Contains stomata; surrounded by guard cells	Allows gases to diffuse; guard cells control opening and closing of stomata
Vascular Bundles	Contains xylem and phloem tissues	Transports water and substances around the plant
Cuticle	A thin, transparent, waxy layer that prevents (stops) water loss by evaporation.	Allow maximum light penetration

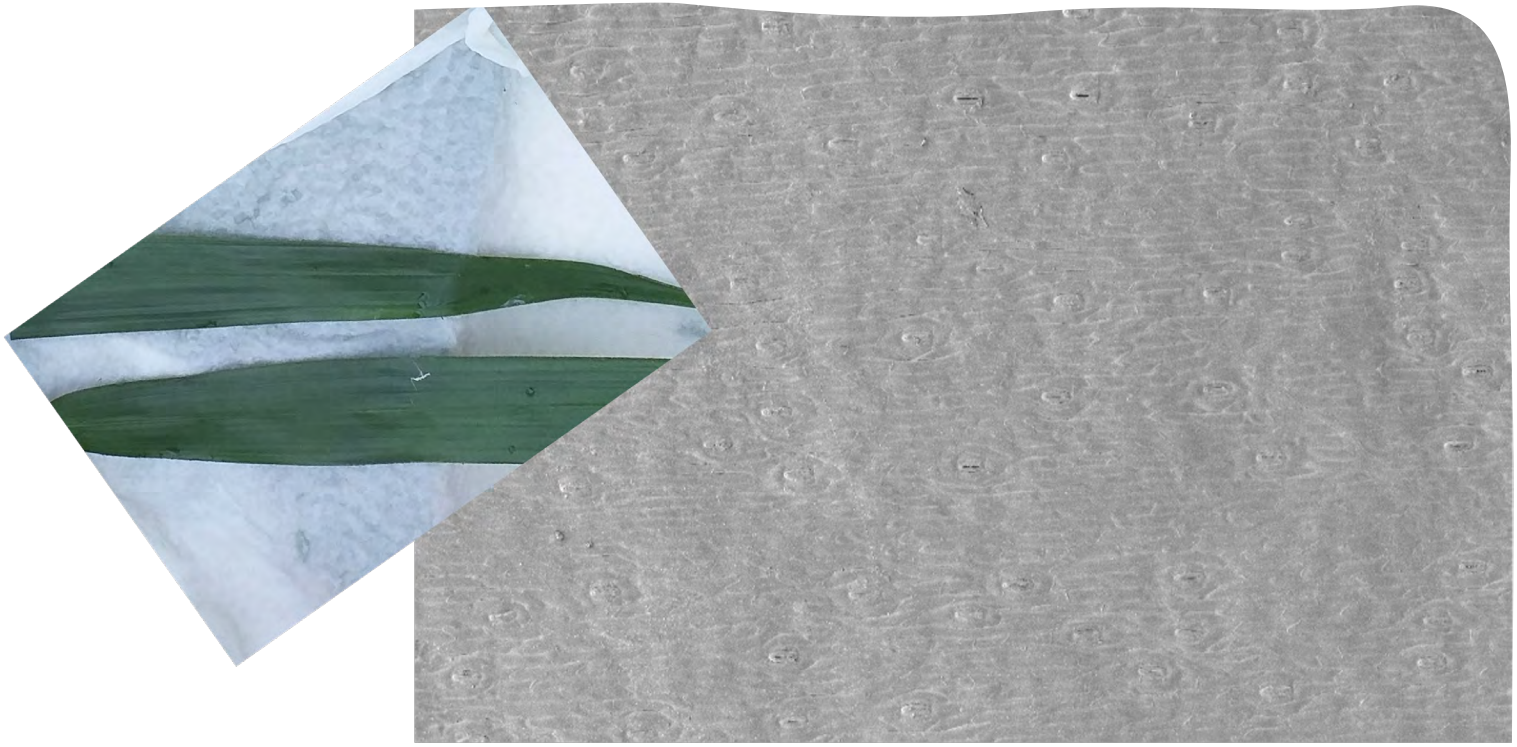
Vascular Bundle





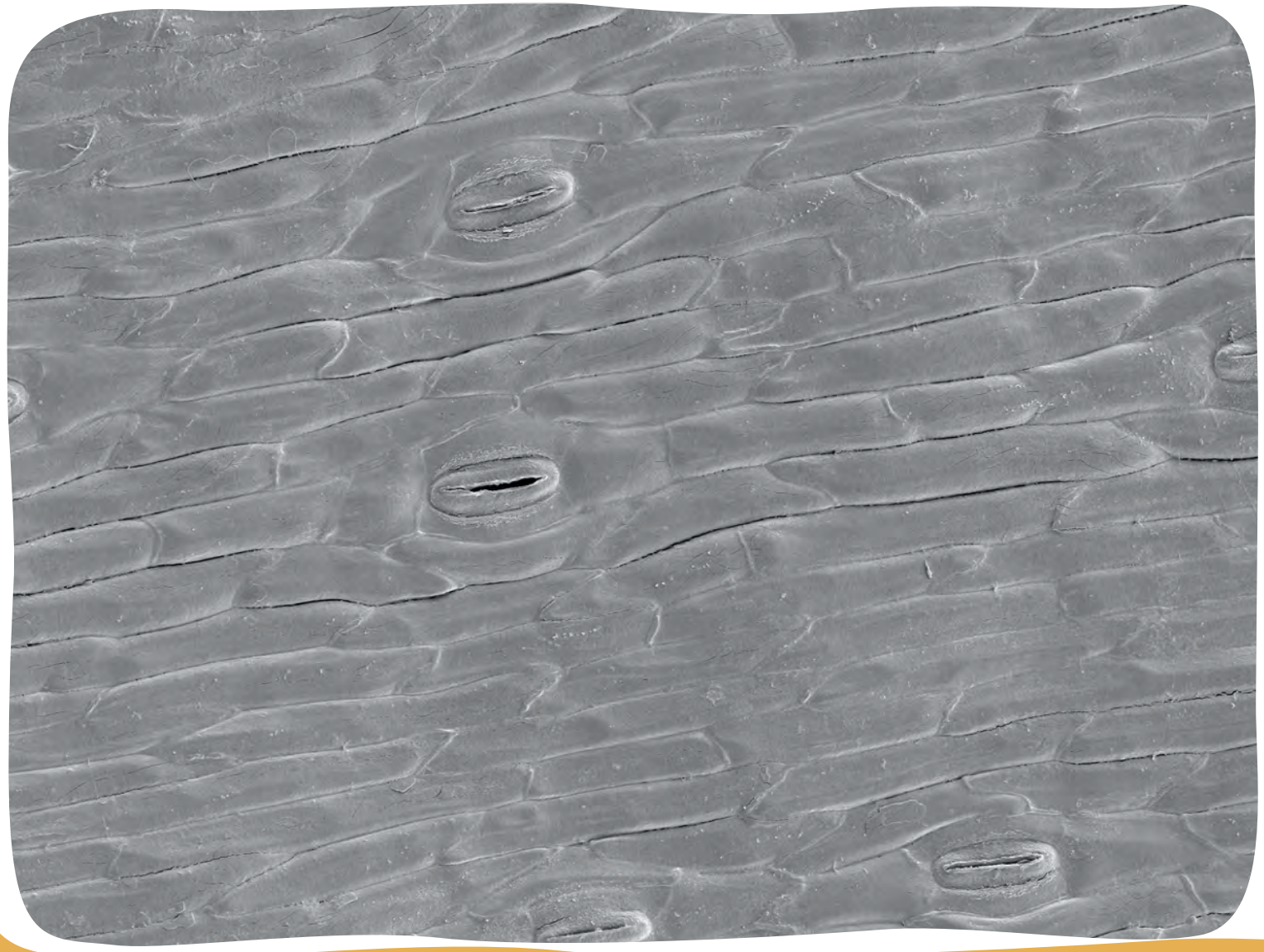
Zooming in on just a corner of the petiole and 1 of the many vascular bundles.
Usually 1-3 large vessels can be seen in each bundle.

Plant Plumbing



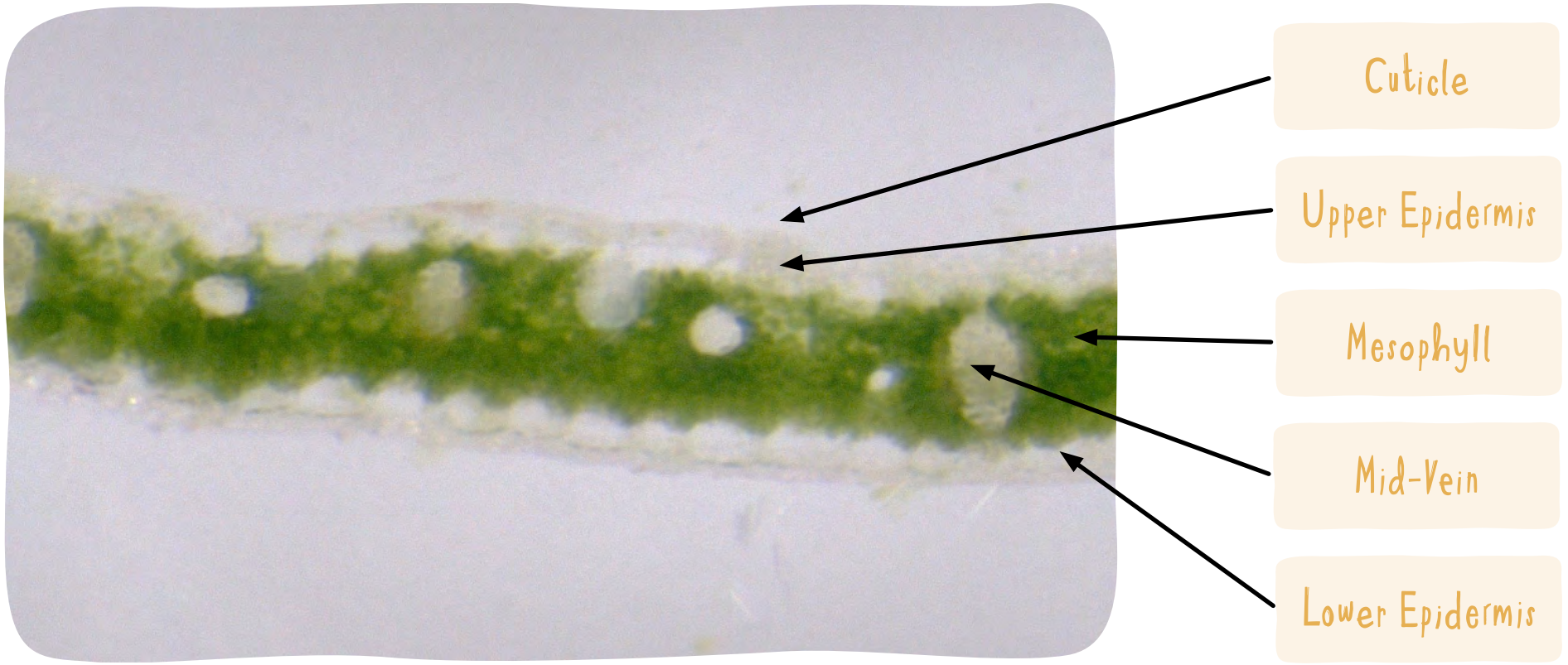
Xylem vessels are usually round. Remember although they look like a large hoses they are less than the width of human hair! They transport water around the plant which is often 20-30m tall.

Plant Plumbing



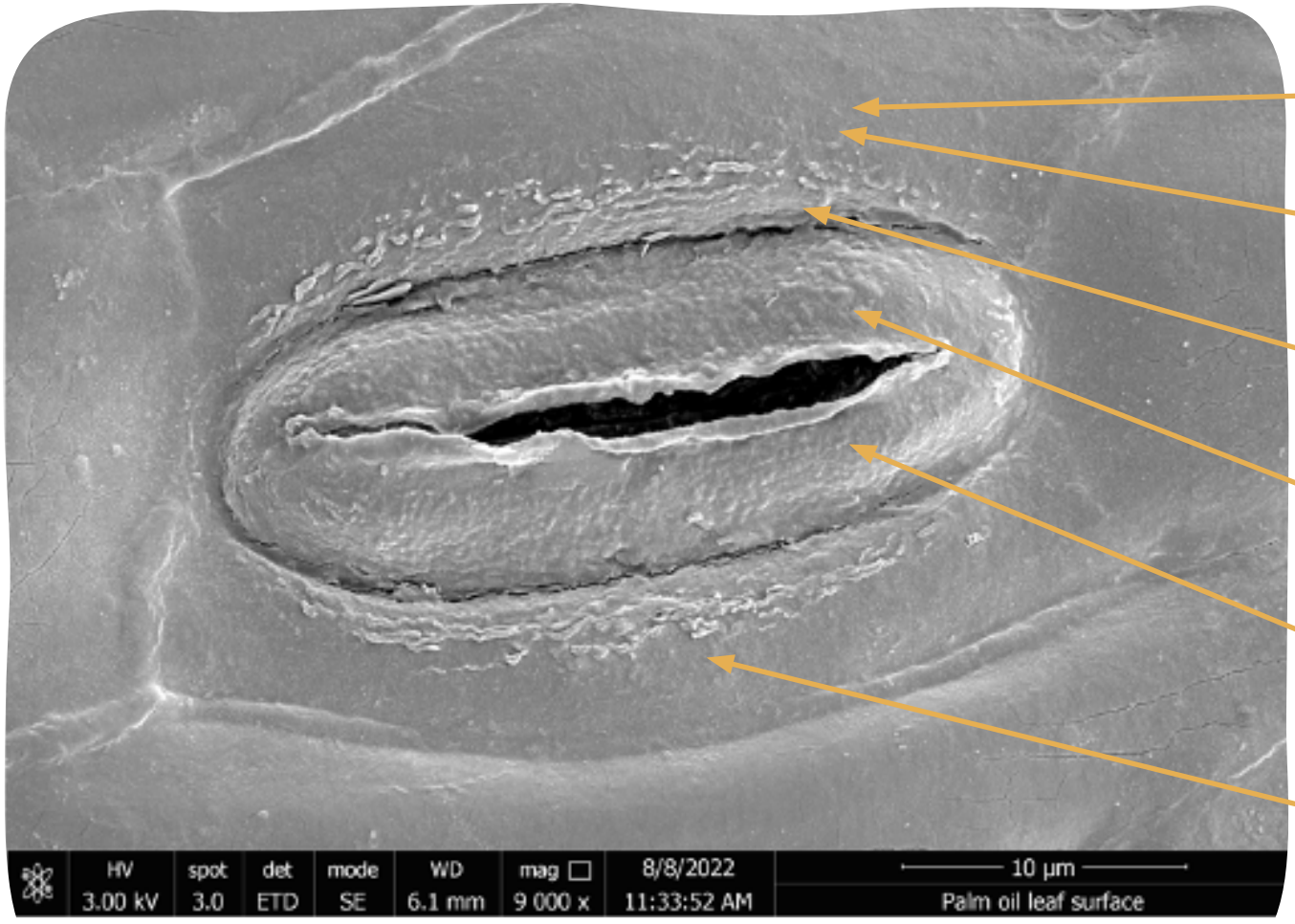
Vessel elements have a more polygonal cell s hape and holes in their cell walls.

Returning To The Leaf Cross-Section



We have torn the leaf across its width and obtained a ‘freeze-fracture’ image of this leaf cell profile.

Leaf Cross-Section



Cuticle

Upper Epidermis

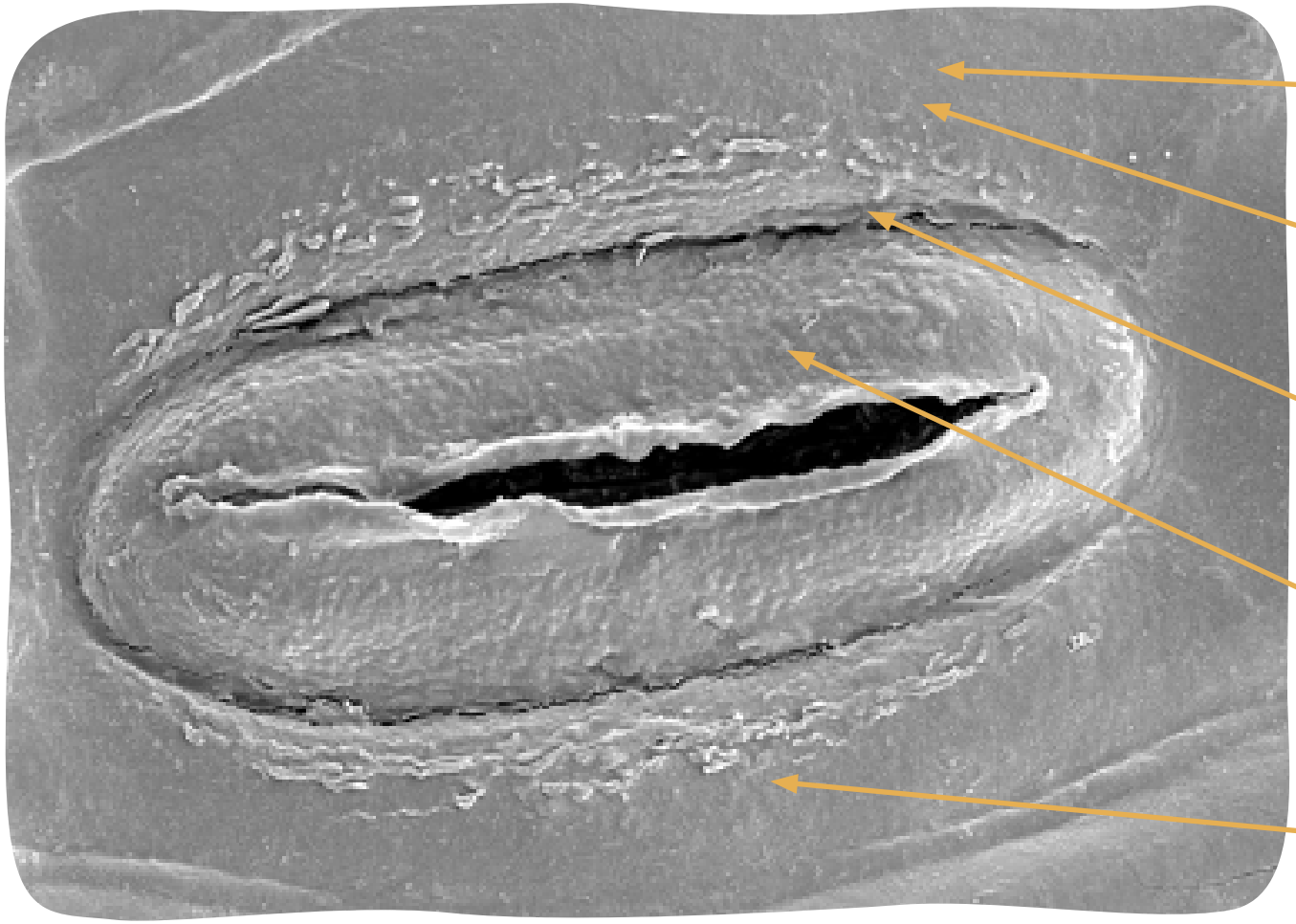
Pallisade Cells

Mesophyll

Vein

Lower Epidermis

Leaf Cross-Section



Cuticle

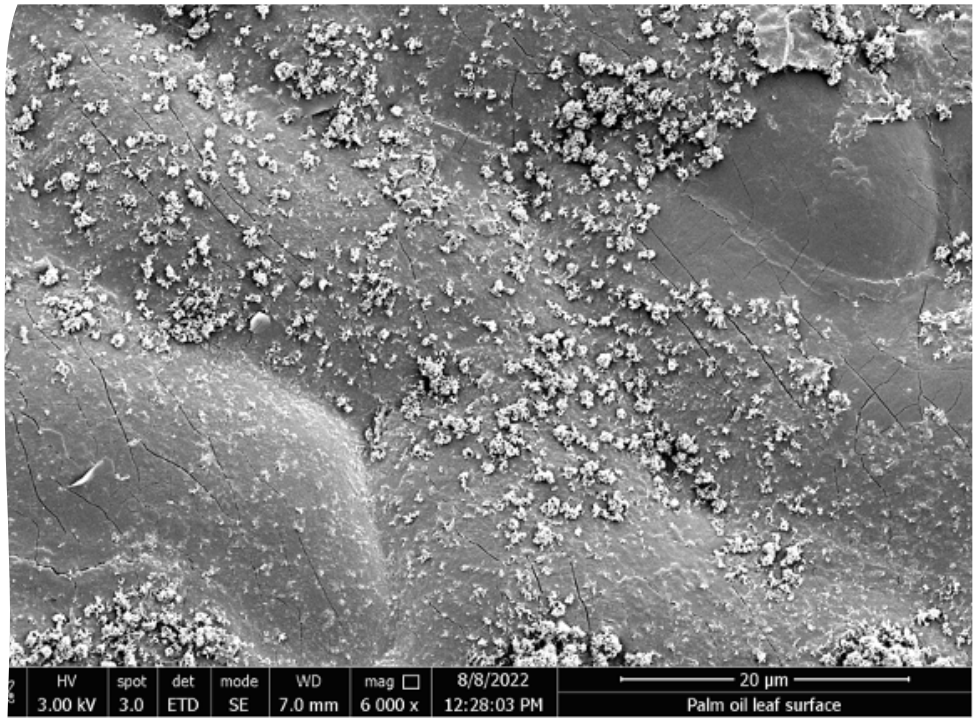
Upper Epidermis

Pallisade Cells

Mesophyll

Lower Epidermis

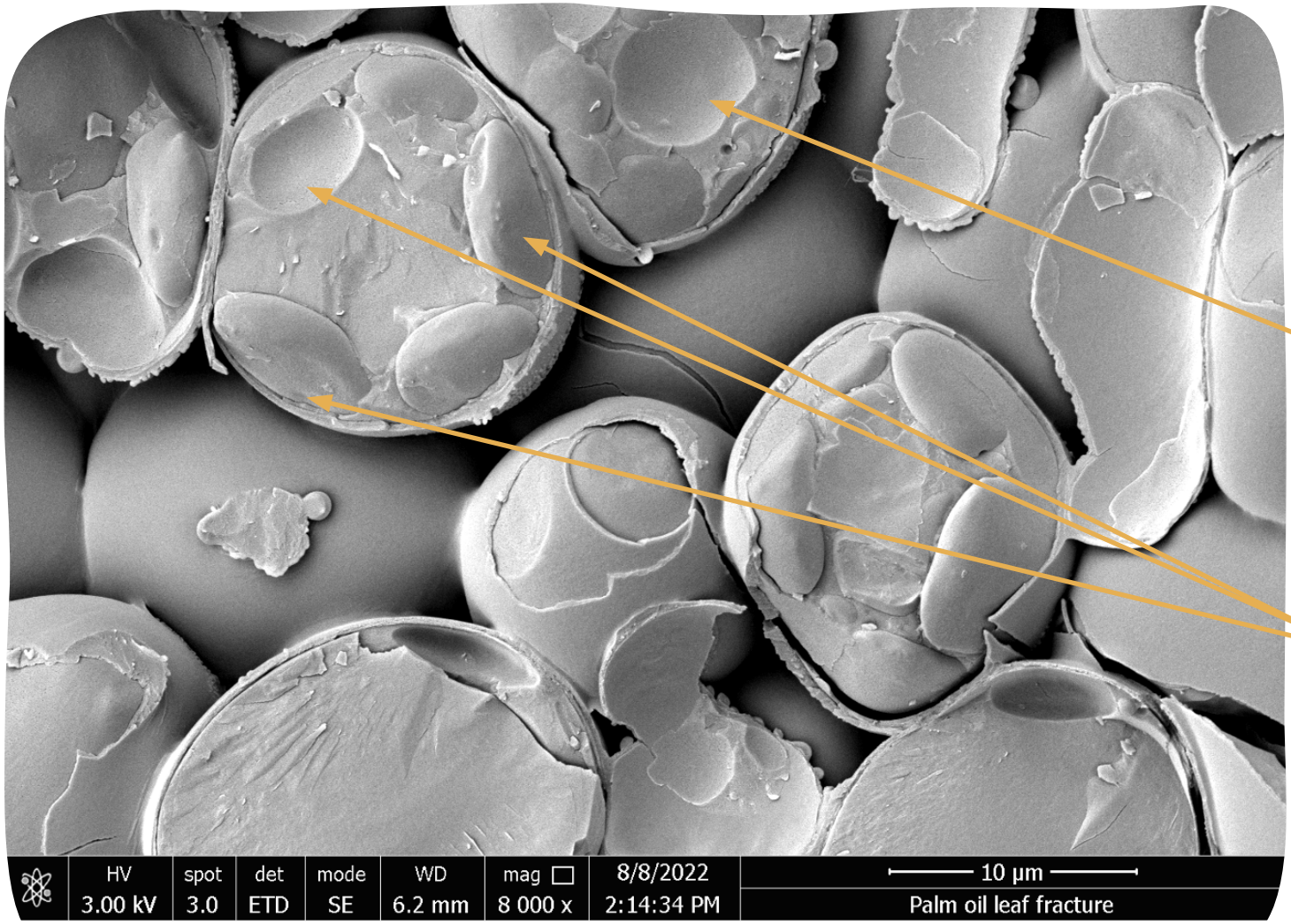
Roles For The Cuticle



- Plant cuticle is the outermost layer of plants, which covers leaves, fruits, flowers, and non-woody stems of higher plants.
- Often covered in waxes
- It protects plants against

  - drought
  - extreme temperatures
  - UV radiation
  - chemical attack
  - mechanical injuries
  - pathogen/pest infection

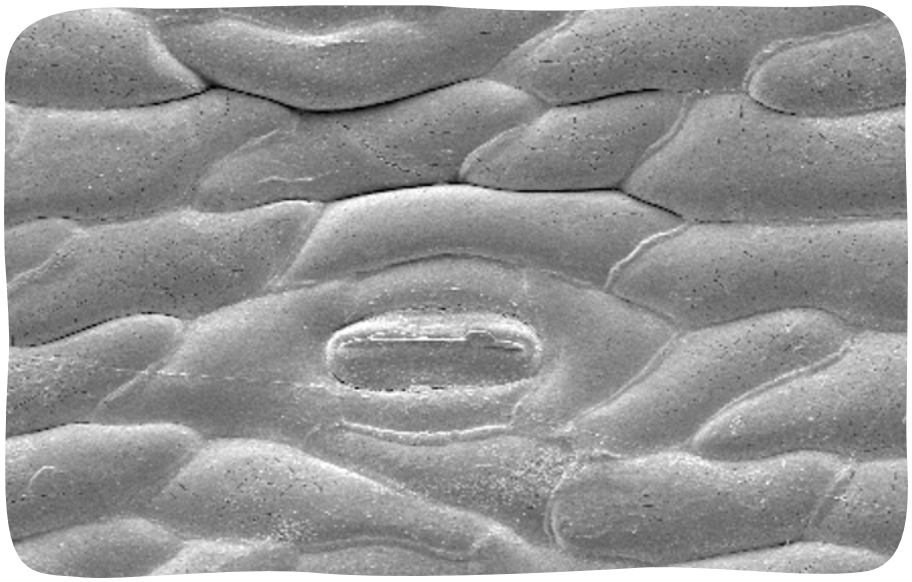
Mesophyll Cells

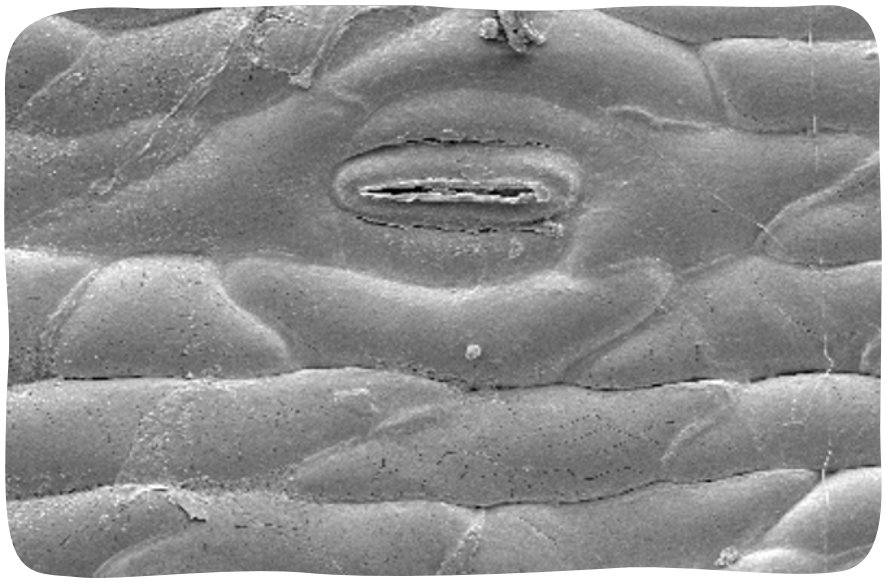


Possible Vacuole

Chloroplasts

Open & Closed Stomates





Stomata are tiny pores on the surface of the leaf that allow gaseous exchange. They are found mainly on the lower surface of the leaf **to reduce water loss by transpiration** - In the hot climates that oil palm grow this is particularly important.

Copyright & Credit

- All light and scanning electron microscope images included in this presentation were created by the Bioimaging department at the John Innes Centre (JIC) and remain the property of JIC.

- **https://www.jic.ac.uk/research-impact/technology-research-platforms/bioimaging-microscopy/**

- The plantation picture (Slide 1) was supplied via the Flickr stream of CIFOR **https://www.cifor.org/** CIFOR is a CGIAR Research Center, and leads the CGIAR Research Program on Forests, Trees and Agroforestry.