Kew Endeavour – The evolution of the mangrove in future eastern Australia

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Image of ancestor plant: Red Mangrove (Rhizophora Mangle)
Plant the evolution is going to start with

- Red Mangrove, *Rhizophora Mangle*
- Native to coastlines in Central American and West coast of Africa and Polynesian islands
- Introduced by humans into Queensland, Hawaii and USA mainland
- Stilt roots for support
- Special holes in bark to take in air
- Root ‘snorkels’ that stick up out of the soil for breathing
- Pneumatophores
- Salt secreting leaves
- Long root systems
Features of Red mangrove

- Pneumatophores – for absorbing O2 when submerged during flooding
- Salt secreting leaves – salt secreted onto leave surface, lost by evaporation, for removing salt when submerged by sea water as this could be toxic to plant
- Fleshy, thick stem – for transporting water and sugars in vascular bundle during hot dry season to minimise water lost by transpiration or evaporation
- Sacrificial leaves – old leaves will be packed with salt from stem which then fall off
- Mangrove reproduction system – see next slide
- Leaves can move to avoid sun during harsh midday sun
Mangrove Reproduction

• Flowering season = all year but max in late spring and summer
• 15cm long
• 40 days in water after dropping from tree
• 15 days to establish roots
• Low seedling mortality aka high chance that seed will survive
• Doesn’t need much light, just waits under canopy and wait to fall
• Propagules
  • Seeds grow whilst attached, then fall off.
  • Allows them to grow during wet seasons, store water and use supply of water during dry season
  • Shape of propagule – green bean shape, cigar like
Environment currently

- Eastern Australia
- Diverse climate: hot and dry summers with cool and moist winters
- Can experience long droughts as well as intense rainfall and severe flooding
- South has a mixed habitat made up of tropical, subtropical and temperature forests, low lying grasslands and shrublands and grasslands, savannahs further inland
- Though a little too dry for forest with only up to 60 inches (150 cm) of rainfall per year, this area is not considered arid land (dry). It is much wetter than the dry scrublands of the central continent and even has small areas of temperate rainforest where rainfall allows
- Divided into 2 main seasons:
  - Wet season: very hot days, high humidity, monsoonal rains and possible cyclones
  - Dry season: warm days, cool nights, low rainfall,
  - Beginning of dry season/end of wet season is when most plants are lush and green
Environment affected by climate change

- Further increase in temperatures, with more extremely hot days and fewer extremely cool days.
- Ongoing sea level rise.
- Further warming and acidification of the oceans around Australia.
- More frequent, extensive, intense and longer-lasting marine heatwaves, suggesting in turn more frequent and severe bleaching events on the Great Barrier Reef, and potentially the loss of many types of coral throughout the tropical reef systems of Australia and globally.
- A decrease in cool-season rainfall across many regions of southern Australia, with more time spent in drought.
- More intense heavy rainfall throughout Australia, particularly for short-duration extreme rainfall events.
- An increase in the number of high fire weather danger days and a longer fire season for southern and eastern Australia.
- Fewer tropical cyclones, but a greater proportion of high-intensity storms, with ongoing large variations from year to year.
Features from other plants

- **Giant redwood:**
  - Thick fire resistant wood
  - Bark chemicals that protect against insects

- **Edelweiss:**
  - Covered in tiny hairs to protect against cold and sunburn
  - Strong roots to keep it anchored in high winds

- **Venus flytrap:**
  - Flowers grow high, away from the leaves
Cactus Adaptations 2

• Photosynthesis takes place in stem – as many desert plants don’t have broad, flat, green leaves as these increase transpiration and therefore water loss, stems have adapted to photosynthesise allowing plant to have spines over leaves
• Stems have a waxy cuticle layer to prevent excess water loss
• Thick fleshy leaves on some cacti store water like succulents
Pneumotaphores

• The surface of these roots are covered with small pores which take up air into spongy tissue, which in turn uses osmotic pathways to spread oxygen throughout the plant as needed.

• Suberin reduces salts from entering plant.
Features on other plants 2

- Greater plantain:
  - Grows well in wet soil, but also copes well with drought
- Creeping buttercup:
  - Bright coloured flowers to attract pollinators
  - Has special air spaces in roots & stems so can grow in very wet soil
- Cactus:
  - Fleshy stem for storing water
  - Flowers open at night
- Stinging nettle:
  - Grows bigger leaves in the shade
  - Leaves are thicker to reduce transpiration
Diagram of our future plant
Stem and Root Adaptations

- Fire resident bark [Great redwood] – made from Tanin, protects against wildfires and hotter temperatures (increased likelihood of wildfires for longer periods in future on East coast due to climate change)

- Thick, fleshy stem [Cactus] – vascular bundle further away from surface, reducing water loss through evaporation, keeps water cool during hot days. Also stores water which is important during longer dry seasons and fewer cooler rain seasons

- Stronger, deeper roots [Edelwiss] – anchors plant during high winds, especially during tropical storms
Leaf Adaptations

- Sunken stomata [Cactus]—stomata fall inwards into sunken pits which traps a layer of moist air, this reduces water potential gradient which reduces water loss.
- Less stomata [Cactus]—less water loss, respond to having low availability to water by closing stomata to prevent water loss.
- Thick, waxy cuticle [Cactus]—much thicker than dicotyledonous plants to reduce water loss through evapotranspiration.
- Shiny cuticle [Cactus]—reflects much of sunlight away.
- Rolled leaves [Cactus]—curled to trap a layer of humid-insulating air, reduces water vapour potential, reducing transpiration and water loss.
- Densely packed mesophyll [Cactus]—helps prevent water loss via evaporation.
- Small hairs (trichomes) [Edelwiss]—trap moist air, reducing water vapour potential, reducing transpiration and water loss.