New Project for Seed Conservation: The Singapore Botanic Gardens Seed Bank

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Images as credited

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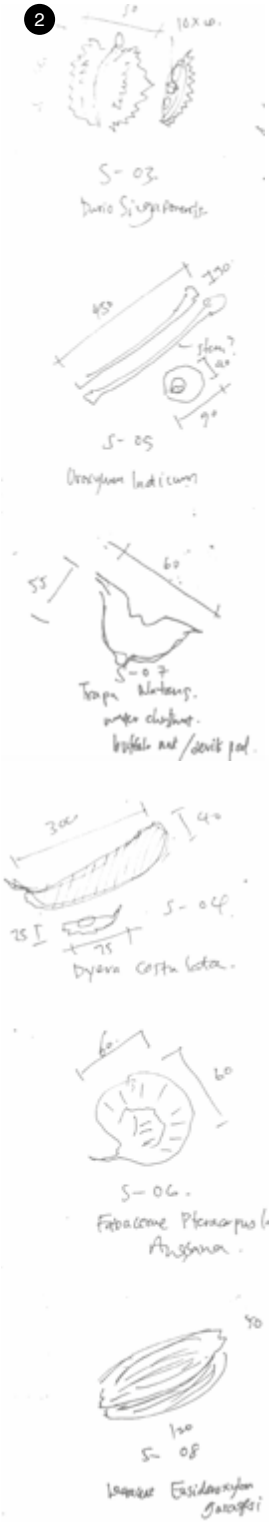

Opened in July 2019, Singapore's first Seed Bank is nestled within the Singapore Botanic Gardens, operating as a conservation, research and education facility within a colonial-style house. It is the largest of five conserved buildings in the former Raffles College built in the late 1920's, but today this building sits within the Singapore Botanic Gardens. As the latest addition of the Singapore Botanic Gardens, the historic building has been repurposed as a Seed Bank to support the Gardens' institutional roles in conservation and research. This is following the successes of the Learning Forest, the Ethnobotany Garden and other new developments.

While many of the seed banks in the world are focused on preserving seeds of nutritional plant varieties, the Singapore Botanic Gardens Seed Bank is focused on protecting biodiversity and genetic diversity in Southeast Asia. The Seed Bank can store the seeds of up to 25,000 plant species, approximately half the total number of plant species in the region, and more than double the current 9,000 plant species in the Gardens' living collection.

Seed banking is usually carried out by drying seeds to a certain moisture content, and then storing them under low temperatures for orthodox seed species. However certain types of seeds, namely recalcitrant seeds, are unable to tolerate the extreme conditions of drying and freezing. One way of storing recalcitrant seeds is through the process of cryopreservation, whereby the embryos or tissues are frozen in liquid nitrogen at -196°C.

Under the guidance of the National Parks Board (NParks), we curated a guided educational journey of the rigorous and technical procedures needed from seed gathering to seed storage, garnering the interest of a wide range of audiences from families and tourists, to people in the specialised field of work. The strategy was to cater to visitors of different ages and backgrounds by making use of various mediums of communication. A unique factor of this exhibition is that visitors have the privilege to witness the staff working in the laboratories, alongside a panel which explains the process, and an interactive element for visitors to engage by mimicking the actions of the professionals. The hands-on experience of testing a look-alike cryogenic vessel, pushing a button to activate the aspirator and pulling up a storage drawer of seeds creates an eye-opening experience. Even within the panel, information is presented in different forms, through short introduction texts, pictures of the processes and actual machines, diagrams for better understanding, simplified axonometric views of the machinery, followed detailed explanations and legends for those who are interested in the more scientific content. Quotes and fun facts dot the exhibition, capturing the interest of visitors and drawing them into the whole process.

1. The majestic main entrance of the Seed Bank © Kenneth Khoo

2. Identifying the specificity of each seed for their display in showcases © WY-TO

3. Nested in the Botanic Gardens, the approach to the Seed Bank immerses visitors through the landscaped garden © AlfaTech

Process of Seed Banking
© NParks

Seed gathering Seed collectors start by gathering seeds from fruiting plants in the wild. One of the challenges lies in determining if the population of seeds meet the minimum quality and quantity for seed sampling.

Seed cleaning Seeds arrive at the Seed Bank in various shapes and sizes, with many of them still contained within the fruit. The seed cleaning process involves removing plant bulk which minimises the risk of rot.

Seed viability In the Germination Lab, a variety of tests are used to determine and monitor the viability of seed collections.

Seed storage Seeds are then dried and stored in freezing conditions to ensure their longevity. A seed's life span doubles for every 1% reduction in its moisture content.

Continuous Research To check the viability of the seed collections, germination tests are set up regularly, repeating at regular intervals depending on the type of seed.

Arriving at the grand staircase of the building, a suspended seed mobile directs the eyes up towards the sunlight streaming in through the atrium. The wall is filled with plaques recognising the community's support and contribution, through NParks' registered charity and Institution of a Public Character, the Garden City Fund, that made the Seed Bank possible. The plaques and the hanging sculpture are fashioned after the fruits and seeds of a Mata Ulat tree (*Kokoona reflexa*), a magnificent tree from the tropical lowland forests of Southeast Asia which can grow up to 55m tall. The brown colour palette of the panels on the lower floor evolve to a shade of green on the upper floor, symbolising the upward movement from the roots in the ground to the foliage of the trees.

As there are countless seed varieties within the tropics alone, we worked closely with NParks to identify the seeds to be exhibited. Going into the fields with the researchers to sketch, take measurements and collect samples was part of the whole process of curating the interesting seeds and figuring out the best mounting methods.

4. Exhibition panels reveal the behind-the-scene actions with props and diagrams. Detailed scentific illustrations can also be found through the entire journey. © WY-TO

5. Detailed scentific illustrations can be found through the entire journey © WY-TO

6. The Suspended seed mobile greets the visitors along the route © WY-TO

7. The Suspended seed mobile greets the visitors along the route © WY-TO

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SEED GATHERING
Process, Techniques and Tools
A seed collector starts by gathering seeds from fruiting plants in the wild. One of the key challenges is in deciding if a population of seeds meets the minimum quality and quantity for seed sampling.
Identifying Target Species
Site Survey
Field Collection

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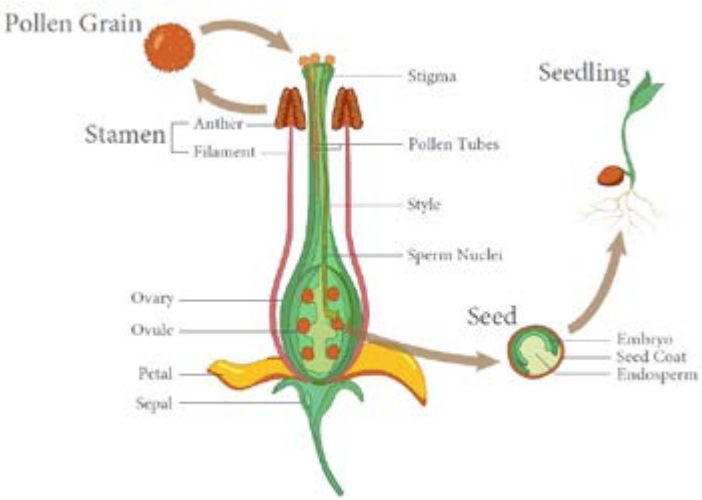
Pollen Grain
Stamen
Anther
Filament
Stigma
Pollen Tubes
Style
Sperm Nuclei
Ovary
Ovule
Petal
Sepal
Seedling
Seed
Embryo
Seed Coat
Endosperm

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SEED BANKING

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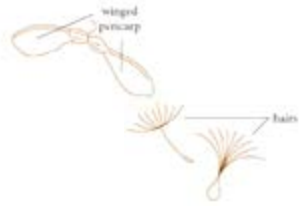
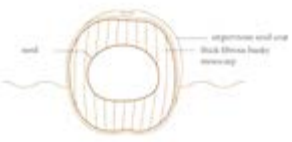
Methods of Seed Dispersal

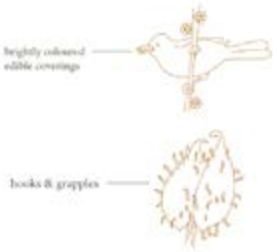


11a. Wind Dispersal

11b. Self-dispersal



11c. Water Dispersal



11d. Animal Dispersal

> “In the end we will conserve only what we love; we will love only what we understand; and we will understand only what we are taught. (Baba Dioum)

Much thought was given in the curation, display, and arrangement of seeds of all shapes and sizes, with each seed requiring a customised stand. From the tiny seed of the Tiger Orchid (*Grammatophyllum speciosum*) which has seeds that are small and powder-like, to the largest seed of Coco De Mer (*Lodoicea maldivica*) weighing up to 18kg, most visitors would not have seen such a large collection of unique seeds, which goes to show the value in preserving such species. Wind-dispersed seeds (e.g. winged fruits from the family Dipterocarpaceae) are held in place by supports at base of the seed, to keep its brittle and fragile wings upright. The fruit of the Nanas Batu (*Phytocrene bracteata*) is displayed within an acrylic casing as its fine hairs are known to cause skin irritation and micro-cuts. The colour of the plinths are also intentionally painted in neutral colours to contrast with the seeds, while the wooden display ensemble grounds it in nature. By doing so, more flexibility is offered to the Seed Bank team to rotate the exhibits. Seeds are definitely treated as valuable artefacts here!

Seeds with similar methods of seed dispersal often share certain characteristics.

Wind dispersal (11a)

Seeds tend to be small and light, equipped with wings or hairs to enable them to glide on air currents. Acrylic stands of various heights give the impression of seeds floating in the wind.

Self-dispersal (11b)

Seeds are ejected with explosive force or simply fall from the parent plant. Plinths are shaped like concentric rings of an explosion.

Water dispersal (11c)

Seeds have thick fibrous coverings or air-filled pockets to help them stay buoyant in water for extended periods of time. The display shelf resembles a water ripple or the lapping of a wave meeting the shore.

Animal dispersal (11d)

Seeds are usually dispersed by attracting animals to ingest them or by clinging to the animals’ bodies with hooks or grapples. Seeds are nestled on plinths of varying heights.

The seed displays are located where there are direct views out towards the grounds of the Singapore Botanic Gardens, which is home to the actual living plant collections. Fabric curtains of the natural landscapes of Singapore line the corridor of seeds, providing the context for where these seeds can be found.

Concluding the exhibition, people are invited to play and recap on the whole process of seed banking, at the same time connecting Singapore’s Seed Bank with other iconic seed banks in Norway, Russia, USA, UK, China, India and Australia. Each of these seed banks share the noble aim to protect biodiversity and feed the world. Visitors are then invited to do their part to sign up as a volunteer to contribute in biodiversity surveys, guided walks, outreach programmes or other areas. This is part of the process of education and the sharing of knowledge, and more importantly inspiring the next generation of botanists and conservationists.

As much remains to be discovered about how these plants can provide solutions to ailments or problems which may not even exist yet, the Seed Bank is a valuable institution to prevent the extinction of species, to bring knowledge to the masses, as well as to benefit future generations. Humanity is already beginning to see the effects of global warming and how the world is at risk of losing many plant species forever. Since it is not always possible to conserve plants in their natural habitats, a holistic conservation plan includes conserving the threatened plant species through the storage of seeds in seed banks.

As the quote by Baba Dioum goes “In the end we will conserve only what we love; we will love only what we understand; and we will understand only what we are taught.” CG

8. Meticulous seed gathering and documenting process. © WY-TO

9. Each seed was treated like a real artefact to ensure its perfect display © AlfaTech

10. Unique seeds, unique displays © WY-TO