PLANTS AND MATHEMATICS

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ABSTRACT

Botanic Gardens provide a rich and unique resource for education, and can play a much needed role in aiding teachers develop exciting and innovative curriculum work for schoolchildren. In order to spread environmental messages to children, it is as well to show the versatility and diversity of plant based activities across as many school topics as possible.

Demonstrating Mathematical principles is an area that is often viewed with trepidation by teachers, but by using plants and Botanic Gardens as a focus, such themes as symmetry, number work, estimation, shape and space, data handling and algebra can be delivered in a more "user friendly" fashion. The bonus is that an environmental message is delivered at the same time.

This workshop explores the themes in mathematics that can be covered using Botanic Gardens and their plant collections.

RESUMEN

Los jardines botánicos proporcionan un recurso rico y único para la educación, y puede jugar un papel muy necesario en la ayuda a los profesores desarrollando trabajos curriculares excitantes e innovadores para los escolares. Con el fin de difundir ideas ambientalistas entre los niños, es muy positivo mostrar la versatilidad y diversidad de las plantas basándose en tantas actividades como sea posible, al igual que en muchas materias escolares.

La demostración de principios matemáticos es un área a menudo vista con temor por los profesores, pero mediante el uso de las plantas y los jardines botánicos como enfoque, temas tales como la simetría, cálculo numérico, estimación, forma y espacio, toma de datos y álgebra pueden ser desarrollados de un modo más «afable para el usuario». La ventaja es que un mensaje ambiental es enviado al mismo tiempo.

Este taller explora los temas matemáticos que pueden abarcarse usando los jardines botánicos y sus colecciones de plantas.

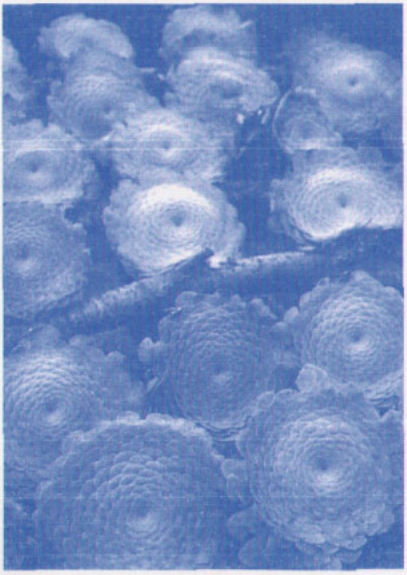
INTRODUCTION

Botanic Gardens are increasingly aware of their role as educators of schoolchilren and educationalists and many now provide a range of topics, focussing on plants, to enhance school programmes. In Britain, where teachers are under pressure to deliver curriculum targets, there is a real need to justify every trip out of shool and programmes offered at Botanic Gardens are coming under scrutiny to see if they meet the needs of schools! Offering programmes that incorporate Mathematics is a sure way to endear the Botanic Garden to the teaching fraternity (or sorority!) Mathematics at primary and lower secondary levels is often a curriculum area that can cause problems for non -specialist teachers. Such teachers are occasionally ill at ease with the mathematical concepts they have to explain, and the result is that both teachers and students suffer in the learning process. Plants can be used as a focus to deliver many mathematical concepts, and often provide a more user -friendly resource for mathematics. Even teachers who are extremely conversant with the delivery of this subject can find that using plants provides a new and exciting approach to Mathematics! And what do the Botanic Gardens get out of the exercise? Information about the plants, their uses and the work of the gardens themselves can be packaged into the teaching resource, ensuring that another outlet is tapped into to deliver vital environmental messages.

USING PLANT FORM AND FUNCTION

There are numerous ways of using plants as a teaching resource for mathematics. Several areas within the British National Curriculum relate to pattern and symmetry and plants show a wonderful diversity of rotationally symmetrical and bi-laterally symmetrical forms, amongst many others! Botanic Gardens have an immense wealth of such shapes to draw on as examples, and often stimulate skills in children for spotting similar symmetrical shapes in their surroundings. Children will naturally absorb the fact that the plant kingdom is extremely diverse at the same time, information that will enhance their science studies. Symmetry and pattern can be noted in flowers, fruits, seeds, leaves and stems, as well as in overall growth patterns; Botanic Gardens can therefore provide a rich resource to work with even in "seasonal" regions.

The principles of Taxonomy are also rooted in Mathematics. Plant classification is based on the number and arrangement of flowering and fruiting parts of the plant, on whether the leaves are arranged alternately, are opposite, are spiralled or are whorled and on whether plant parts are present or absent. All taxonomists play the "numbers game" to identify their plant! It can be so much fun to play Sherlock Holmes and track down your plant by counting numbers of flower parts, or examining their arrangement! Children



"Enlargements" seen in rows of Aeoniums in the nursery of Jardín Botánico Canario «Viera y Clavijo»

at Kew become taxonomists at the age of 7 or 8, and revel in the Latin names at the same time! If children can pronounce *Tyrranosaurus* they can certainly manage Monocotyledon; its the adults that have the problem! As children look to see if their plants have their flowering parts in 3's (monocotlyedons) or in 4s' / 5's (dicotyledons), they also take on board the name and function of the parts they are looking at; this instantly builds links to the science curriculum.

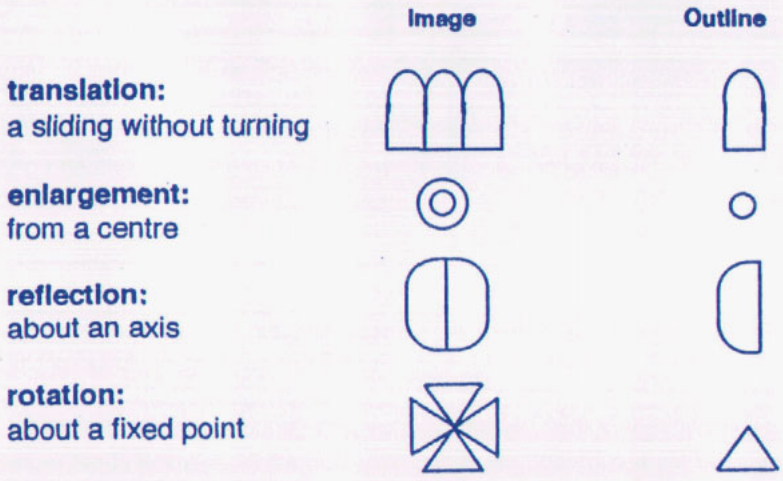
Children can also be asked to present their information on aspects of the plants in a variety of ways. This allows teachers to develop such skills as table or graph production; in some instances the development of skills in Information Technology will be even more appropriate.

Certain games are also very suitable for developing number skills. An environmental game on how pollution is passed down through food chains involves children taking on the role of elements within a selected food chain; the starting point is with minerals etc in the soil and soil water, some of which may be polluted. These "polluted" and "non-polluted" resources are represented by coloured paper stickers for polluted water or minerals which are "taken up" and white paper stickers for non-polluted materials which are "taken up". The number of children at each stage of the chain is important; children start to understand the "pyramid of numbers" effect in food webs and chains. For example teachers could select children to role play: 20 plants, 8 herbivores, 3 carnivores, 1 top carnivore etc. The number of pieces of paper representing polluted and non-polluted "food" that is "taken up" (ie collected / eaten) through each part of the food chain can be counted and monitored as it is passed on from group to group. There are several oppportunities for mathematics to be used here, but in an enjoyable way... and the environmental messages are getting passed on as well!

One particularly exciting way to develop several mathematical themes is to

incorporate them into a "Mathematics Trail" for your garden. This idea, first developed at Kew by Dr. Mary Harris of London University, provides a fun way for children, and also adults, to "discover" the plants and mathematics at the same time. Dr Harris developed an innovative trail around the Princess of Wales Conservatory, Kew, using diversity of plant form and plant symmetry found throughout the glasshouse; you could however also use the pattern and symmetry of landmarks or buildings well known on your site to excellent effect.

Some simple transformations



Symmetry in Mathematics is the ability of a shape to fit its own outline in more than one way and can be seen for example in the following ways: (see diagram and notes)

The workshop session participents at Las Palmas, having looked at various aspects of symmetry eg rotation, transformation, reflection etc. were launched on an unexpected fact finding mission across the Garden to procure some examples of plants to use for a "Las Palmas Mathematics Trail". Several came back, (which proves that at least some participents were still awake at the end of the workshop!) and may still, at some future date, find themselves on sheets for use by visitors to Jardín Botánico Canario "Viera y Clavijo".

Useful Resources and Contacts

Dr Mary Harris, University of London Institute of Education

The Education Officer, Royal Botanic Gardens, Kew, Richmond, Surrey

The Education Officer, Chelsea Physic Garden, London

The Education Section, The Natural History Museum, London

"Common Threads", a resource based on Mathematics and Textiles

from Mathematics in Work, Statistics and Computing, University of London Institute of Education, 28 Woburn Square, London WC1H 0AA.