Botanic Gardens Conservation International Education Review

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# **Education and technology:** Responding to a global pandemic



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BOTANIC GARDENS CONSERVATION INTERNATIONAL



THE FAIRCHILD CHALLENGE: REFLECTIONS ON OUR SOCIAL ROLE         Amy Padolf, Brian Sidoti, Brenna Kays, Stacy Assael and Olga Tserej      063         A VIRTUAL VEGETABLE GARDEN: AN ENCOURAGING EXPERIENCE      103         IN ALCALÁ BOTANIC GARDENS Blanca Olivé      103         USING TECHNOLOGY TO ENGAGE REGE'S AUDIENCE DURING      103         THE PANDEMIC Cath Ashby, Susie Kelpie, Jane Robertson, Laura Gallagher & Elinor Leslie      133         THE CHALLENGES AND OPPORTUNITIES CAUSED BY COVID-19      177         Ximin Wang      177         CLOSE ENCOUNTERS OF THE DIGITAL KIND: STAYING SOCIALLY      199         CONNECTED WHEN WE MUST STAY PHYSICALLY DISTANCED Julia Watson      199         EDUCATING TO CONSERVE NATURE: AN AUGMENTED REALITY       EXPERIENCE INBOTANICAL GARDEN OF MEDELLIN         Dubán Canal, Ana María Benavides & Marcela Pérez      203         EMBRACING UNCERTAINTY: ENGAGING THE MORTON ARBORETUM'S      206         SEARCH FOR OPTIMAL WAYS: NEW HORIZONS FOR CONTACTLESS       EDUCATION VIri Kalugin & Lara Musinova      333         HOW CAN ENVIRONMENTAL EDUCATION OVERCOME THE      336         HUARJCALE EARNING: ADAPTING SCHOOL PROGRAMS      424         DUCATION DURING THE COVID-19 PANDEMIC      336         HUARJCALE ELEARNING: AN EXPERIENCE WITH INTERACTIVE GAMESIS IN TIMES      425		
Amy Padolf, Brian Sidoti, Brenna Kays, Stacy Assael and Olga Tserej      005         A VIRTUAL VEGETABLE GARDEN: AN ENCOURAGING EXPERIENCE      10         IN ALCALÁ BOTANIC GARDENS Blanca Olivé      10         USING TECHNOLOGY TO ENGAGE REGE'S AUDIENCE DURING      13         ITHE CHALLENGES AND OPPORTUNITIES CAUSED BY COVID-19      13         Ximin Wang      17         CLOSE ENCOUNTERS OF THE DIGITAL KIND: STAYING SOCIALLY      19         CONNECTED WHEN WE MUST STAY PHYSICALLY DISTANCED Julia Watson      19         EDUCATING TO CONSERVE NATURE: AN AUGMENTED REALITY      23         EDUCATING TO CONSERVE NATURE: AN AUGMENTED REALITY      236         EDUCATION UNCERTAINTY: ENGAGING THE MORTON ARBORETUM'S      236         AUDIENCES DURING THE PANDEMIC Preston Bautista      236         EDUCATION Vuri Kalugin & Lara Musinova      306         HOW CAN ENVIRONMENTAL EDUCATION OVERCOME THE      336         CHALLENGES FACED DURING A PANDEMIC? Nacija Simbera Hemetrio      336         SHANGHAI BOTANICAL GARDEN'S INNOVATIVE VIRTUAL      426         SCIENCE EDUCATION DURING THE COVID-19 PANDEMIC      426         HUANG SCUND-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole      336         SHANGHAI BOTANICAL GARDEN'S INNOVATIVE VIRTUAL      426		04
IN ALCALÀ BOTANIC GARDENS Blanca Olivé      10         USING TECHNOLOGY TO ENGAGE RBGE'S AUDIENCE DURING      13         THE PANDEMIC Cath Ashby, Susie Kelpie, Jane Robertson,      13         Laura Gallagher & Elinor Leslie      17         THE CHALLENGES AND OPPORTUNITIES CAUSED BY COVID-19      17         Ximin Wang      17         CLOSE ENCOUNTERS OF THE DIGITAL KIND: STAYING SOCIALLY      19         CONNECTED WHEN WE MUST STAY PHYSICALLY DISTANCED Julia Watson      19         EDUCATING TO CONSERVE NATURE: AN AUGMENTED REALITY       EXPERIENCE IN BOTANICAL GARDEN OF MEDELLÍN         Dubán Canal, Ana María Benavides & Marcela Pérez      203         EMBRACING UNCERTAINTY: ENGAGING THE MORTON ARBORETUM'S      206         AUDIENCES DURING THE PANDEMIC Preston Bautista      206         SEARCH FOR OPTIMAL WAYS: NEW HORIZONS FOR CONTACTLESS      300         EDUCATION Yuri Kalugin & Lara Musinova      300         HOW CAN ENVIRONMENTAL EDUCATION OVERCOME THE      306         CHALENGES FACED DURING THE COVID-19 PANDEMIC      306         Huang Meilin, Feng Shucheng & WU Hong      306         INTERACTIVE DISTANCE LEARNING: ADAPTING SCHOOL PROGRAMS      306         URING COVID-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole      306         STANY		06
THE PANDEMIC Cath Ashby, Susie Kelpie, Jane Robertson, Laura Gallagher & Elinor Leslie      13         THE CHALLENGES AND OPPORTUNITIES CAUSED BY COVID-19 Ximin Wang      17         CLOSE ENCOUNTERS OF THE DIGITAL KIND: STAYING SOCIALLY CONNECTED WHEN WE MUST STAY PHYSICALLY DISTANCED Julia Watson      19         EDUCATING TO CONSERVE NATURE: AN AUGMENTED REALITY EXPERIENCE IN BOTANICAL GARDEN OF MEDELLÍN Dubán Canal, Ana María Benavides & Marcela Pérez      23         EMBRACING UNCERTAINTY: ENGAGING THE MORTON ARBORETUM'S AUDIENCES DURING THE PANDEMIC Preston Bautista      26         SEARCH FOR OPTIMAL WAYS: NEW HORIZONS FOR CONTACTLESS EDUCATION Yuri Kalugin & Lara Musinova      300         HOW CAN ENVIRONMENTAL EDUCATION OVERCOME THE CHALLENGES FACED DURING A PANDEMIC? Nadja Simbera Hemetrio      336         SHANGHAI BOTANICAL GARDEN'S INNOVATIVE VIRTUAL SCIENCE EDUCATION DURING THE COVID-19 PANDEMIC Huang Meilin, Feng Shucheng & Wu Hong      366         INTERACTIVE DISTANCE LEARNING: ADAPTING SCHOOL PROGRAMS DURING COVID-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole      39         #STAYHOMEWITHGB: BRINGING A PIECE OF THE GARDENS TO VISITORS VIRTUALLY Ong Yan Szu      42         FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio      43         USING THE WHOLE MEDIA AND PLATFORMS Moyan Zhou, Yichen Wang & Ting Lu      43         EXPERIENCE OF VMU BOTANICAL GARDEN: ENGAGING VISITORS WITH TECHNOLOGIES Nerijus Jurkonis		10
Ximin Wang      17         CLOSE ENCOUNTERS OF THE DIGITAL KIND: STAYING SOCIALLY CONNECTED WHEN WE MUST STAY PHYSICALLY DISTANCED Julia Watson      19         EDUCATING TO CONSERVE NATURE: AN AUGMENTED REALITY EXPERIENCE IN BOTANICAL GARDEN OF MEDELLÍN Dubán Canal, Ana María Benavides & Marcela Pérez      23         EMBRACING UNCERTAINTY: ENGAGING THE MORTON ARBORETUM'S AUDIENCES DURING THE PANDEMIC Preston Bautista      266         SEARCH FOR OPTIMAL WAYS: NEW HORIZONS FOR CONTACTLESS EDUCATION Yuri Kalugin & Lara Musinova      300         HOW CAN ENVIRONMENTAL EDUCATION OVERCOME THE CHALLENGES FACED DURING A PANDEMIC? Nadja Simbera Hemetrio      300         SHANGHAI BOTANICAL GARDEN'S INNOVATIVE VIRTUAL SCIENCE EDUCATION DURING THE COVID-19 PANDEMIC Huang Meilin, Feng Shucheng & Wu Hong      306         INTERACTIVE DISTANCE LEARNING: ADAPTING SCHOOL PROGRAMS DURING COVID-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole      422         FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES OF DISTANCE LEARNING ANTONELLA GRADENS TO VISITORS VIRTUALLY Ong Yan Szu      442         FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio      455         USING THE WHOLE MEDIA AND PLATFORMS Moyan Zhou, Yichen Wang & Ting Lu      54         EXPERIENCE OF YMU BOTANICAL GARDENT ENGAGING VISITORS WITH TECHNOLOGIES Nerijus Jurkonis & Vesta Aleknavičiūtė      51         PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS- DUSO	THE PANDEMIC Cath Ashby, Susie Kelpie, Jane Robertson,	13
CONNECTED WHEN WE MUST STAY PHYSICALLY DISTANCED Julia Watson		17
EXPERIENCE IN BOTANICAL GARDEN OF MEDELLÍN      23         Dubán Canal, Ana María Benavides & Marcela Pérez      23         EMBRACING UNCERTAINTY: ENGAGING THE MORTON ARBORETUM'S      26         SEARCH FOR OPTIMAL WAYS: NEW HORIZONS FOR CONTACTLESS      30         EDUCATION Yuri Kalugin & Lara Musinova      30         HOW CAN ENVIRONMENTAL EDUCATION OVERCOME THE      30         CHALLENGES FACED DURING A PANDEMIC? Nadja Simbera Hemetrio      33         SHANGHAI BOTANICAL GARDEN'S INNOVATIVE VIRTUAL      30         SCIENCE EDUCATION DURING THE COVID-19 PANDEMIC      30         Huang Meilin, Feng Shucheng & Wu Hong      30         INTERACTIVE DISTANCE LEARNING: ADAPTING SCHOOL PROGRAMS      30         DURING COVID-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole      30         #STAYHOMEWITHGB: BRINGING A PIECE OF THE GARDENS TO VISITORS      42         FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES      45         OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio      46         USING THE WHOLE MEDIA AND PLATFORMS      46         Moyan Zhou, Yichen Wang & Ting Lu      46         EXPERIENCE OF YMU BOTANICAL GARDEN: ENGAGING VISITORS      51         USING THE WHOLE MEDIA AND PLATFORMS      54		19
AUDIENCES DURING THE PANDEMIC Preston Bautista      26         SEARCH FOR OPTIMAL WAYS: NEW HORIZONS FOR CONTACTLESS      30         EDUCATION Yuri Kalugin & Lara Musinova      30         HOW CAN ENVIRONMENTAL EDUCATION OVERCOME THE CHALLENGES FACED DURING A PANDEMIC? Nadja Simbera Hemetrio      33         SHANGHAI BOTANICAL GARDEN'S INNOVATIVE VIRTUAL SCIENCE EDUCATION DURING THE COVID-19 PANDEMIC      36         Huang Meilin, Feng Shucheng & Wu Hong      36         INTERACTIVE DISTANCE LEARNING: ADAPTING SCHOOL PROGRAMS DURING COVID-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole      39         #STAYHOMEWITHGB: BRINGING A PIECE OF THE GARDENS TO VISITORS VIRTUALLY Ong Yan Szu      42         FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio      45         USING THE WHOLE MEDIA AND PLATFORMS Moyan Zhou, Yichen Wang & Ting Lu      48         EXPERIENCE OF YMU BOTANICAL GARDEN: ENGAGING VISITORS WITH TECHNOLOGIES Nerijus Jurkonis & Vesta Aleknavičiūtė      51         PIONEERS IN PUBLIC ENGAGEMENT GARDENING FROM THE HEART – DI SOUTHWELL'S STORY Roana O'Neill      54         PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS – ADAPTING TO THE 'NEW NORMAL' Shiona Mackie      554	EXPERIENCE IN BOTANICAL GARDEN OF MEDELLÍN	23
EDUCATION Yuri Kalugin & Lara Musinova      30         HOW CAN ENVIRONMENTAL EDUCATION OVERCOME THE CHALLENGES FACED DURING A PANDEMIC? Nadja Simbera Hemetrio      33         SHANGHAI BOTANICAL GARDEN'S INNOVATIVE VIRTUAL SCIENCE EDUCATION DURING THE COVID-19 PANDEMIC Huang Meilin, Feng Shucheng & Wu Hong      36         INTERACTIVE DISTANCE LEARNING: ADAPTING SCHOOL PROGRAMS DURING COVID-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole      39         #STAYHOMEWITHGB: BRINGING A PIECE OF THE GARDENS TO VISITORS VIRTUALLY Ong Yan Szu      422         FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio      45         USING THE WHOLE MEDIA AND PLATFORMS Moyan Zhou, Yichen Wang & Ting Lu      48         EXPERIENCE OF YMU BOTANICAL GARDEN: ENGAGING VISITORS WITH TECHNOLOGIES Nerijus Jurkonis & Vesta Aleknavičiūtė      51         PIONEERS IN PUBLIC ENGAGEMENT GARDENING FROM THE HEART – DI SOUTHWELL'S STORY Roana O'Neill      54         PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS – ADAPTING TO THE 'NEW NORMAL' Shiona Mackie      55		26
CHALLENGES FACED DURING A PANDEMIC? Nadja Simbera Hemetrio      33         SHANGHAI BOTANICAL GARDEN'S INNOVATIVE VIRTUAL      36         SCIENCE EDUCATION DURING THE COVID-19 PANDEMIC      36         Huang Meilin, Feng Shucheng & Wu Hong      36         INTERACTIVE DISTANCE LEARNING: ADAPTING SCHOOL PROGRAMS      36         DURING COVID-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole      39         #STAYHOMEWITHGB: BRINGING A PIECE OF THE GARDENS TO VISITORS      42         FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES      42         OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio      43         USING THE WHOLE MEDIA AND PLATFORMS      48         Moyan Zhou, Yichen Wang & Ting Lu      48         EXPERIENCE OF VMU BOTANICAL GARDEN: ENGAGING VISITORS      51         WITH TECHNOLOGIES Nerijus Jurkonis & Vesta Aleknavičiūtė      54         PIONEERS IN PUBLIC ENGAGEMENT GARDENING FROM THE HEART -      54         DI SOUTHWELL'S STORY Roana O'Neill      54         PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS -      55         ADAPTING TO THE 'NEW NORMAL' Shiona Mackie      55		30
SCIENCE EDUCATION DURING THE COVID-19 PANDEMIC Huang Meilin, Feng Shucheng & Wu Hong36INTERACTIVE DISTANCE LEARNING: ADAPTING SCHOOL PROGRAMS DURING COVID-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole39#STAYHOMEWITHGB: BRINGING A PIECE OF THE GARDENS TO VISITORS VIRTUALLY Ong Yan Szu42FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio45USING THE WHOLE MEDIA AND PLATFORMS Moyan Zhou, Yichen Wang & Ting Lu48EXPERIENCE OF YMU BOTANICAL GARDEN: ENGAGING VISITORS WITH TECHNOLOGIES Nerijus Jurkonis & Vesta Aleknavičiūtė51PIONEERS IN PUBLIC ENGAGEMENT GARDENING FROM THE HEART- DI SOUTHWELL'S STORY Roana O'Neill54PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS- ADAPTING TO THE 'NEW NORMAL' Shiona Mackie55		33
DURING COVID-19 Katelin Gaeth, Julie Matthews Blue & Matthew Cole      39         #STAYHOMEWITHGB: BRINGING A PIECE OF THE GARDENS TO VISITORS      42         #URIUALLY Ong Yan Szu      42         FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES      45         OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio      45         USING THE WHOLE MEDIA AND PLATFORMS      46         Moyan Zhou, Yichen Wang & Ting Lu      46         EXPERIENCE OF VMU BOTANICAL GARDEN: ENGAGING VISITORS      51         PIONEERS IN PUBLIC ENGAGEMENT GARDENING FROM THE HEART –      54         DI SOUTHWELL'S STORY Roana O'Neill      55         PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS –      555         ADAPTING TO THE 'NEW NORMAL' Shiona Mackie      555	SCIENCE EDUCATION DURING THE COVID-19 PANDEMIC	36
VIRTUALLY Ong Yan Szu      422         FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES      45         OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio      45         USING THE WHOLE MEDIA AND PLATFORMS      46         Moyan Zhou, Yichen Wang & Ting Lu      48         EXPERIENCE OF VMU BOTANICAL GARDEN: ENGAGING VISITORS      51         PIONEERS IN PUBLIC ENGAGEMENT GARDENING FROM THE HEART –      54         DI SOUTHWELL'S STORY Roana O'Neill      54         PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS –      555         ADAPTING TO THE 'NEW NORMAL' Shiona Mackie      555		39
OF DISTANCE LEARNING Antonella Grano, Luigi Forte & Mario C. De Tullio      45         USING THE WHOLE MEDIA AND PLATFORMS Moyan Zhou, Yichen Wang & Ting Lu      46         EXPERIENCE OF VMU BOTANICAL GARDEN: ENGAGING VISITORS WITH TECHNOLOGIES Nerijus Jurkonis & Vesta Aleknavičiūtė      51         PIONEERS IN PUBLIC ENGAGEMENT GARDENING FROM THE HEART- DI SOUTHWELL'S STORY Roana O'Neill      54         PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS – ADAPTING TO THE 'NEW NORMAL' Shiona Mackie      555		42
Moyan Zhou, Yichen Wang & Ting Lu      48         EXPERIENCE OF VMU BOTANICAL GARDEN: ENGAGING VISITORS      51         WITH TECHNOLOGIES Nerijus Jurkonis & Vesta Aleknavičiūtė      51         PIONEERS IN PUBLIC ENGAGEMENT GARDENING FROM THE HEART – DI SOUTHWELL'S STORY Roana O'Neill      54         PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS – ADAPTING TO THE 'NEW NORMAL' Shiona Mackie      555		45
WITH TECHNOLOGIES Nerijus Jurkonis & Vesta Aleknavičiūtė      51         PIONEERS IN PUBLIC ENGAGEMENT GARDENING FROM THE HEART –      54         DI SOUTHWELL'S STORY Roana O'Neill      54         PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS –      554         ADAPTING TO THE 'NEW NORMAL' Shiona Mackie      555		48
DI SOUTHWELL'S STORY Roana O'Neill PIONEERS IN PUBLIC ENGAGEMENT FRIENDS OF BOTANIC GARDENS – ADAPTING TO THE 'NEW NORMAL' Shiona Mackie		51
ADAPTING TO THE 'NEW NORMAL' Shiona Mackie		54
RESOURCES		55
	RESOURCES	56

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#### Forthcoming Issue

Volume 18 Number 1: Climate change Cover Photo: A family interacts with a DBG instructor during a live virtual program (Denver Botanic Gardens/Scott Dressel-Martin) Desian:

John Morgan www.seascapedesign.co.uk

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### ← Kids playing Game 1 ©Giovanni Signorile

Botany is beautiful, but we need new ways to make it more appealing. Too many names and details that are hard to remember are often discouraging, especially for kids. The best way to overcome this problem is to get acquainted with plants directly in the wild, or in botanic gardens. Alternatively, we can use interactive computer games (serious games) to learn about botany with a bit of fun. Let's play!



↑ Silurian landscape with horsetails Design: Mario De Tullio, Pooya srl.

"The game on flower development has been very useful to understand how gene expression works, and what a mutant is" Marco, 19 yo, 1styear University student



↑ Jurassic landscape with Cycas plants Design: Mario De Tullio, Pooya srl.

# FUN AND SERIOUS: AN EXPERIENCE WITH INTERACTIVE GAMES IN TIMES OF DISTANCE LEARNING

ven though plants are everywhere around us and we all use them for the most diverse purposes, the psychological attitude known as plant blindness is surprisingly widespread. The definition of plant blindness (Wandersee and Schussler, 1999) includes the inability to perceive plants as living organisms, let alone appreciating the remarkable biodiversity found in the plant lineage as a consequence of a billion years of evolution. Spreading botanical education as a way of addressing plant blindness is a primary goal of botanic gardens, and should be a priority for all educational agencies and institutions. As part of the science communication activities of the Botanic Garden Museum of the University of Bari (Italy), we started the E-Mo.Ve! project, an acronym of the Italian Evoluzione del Mondo Vegetale (literally "Evolution of the Plant World"). Evolution was chosen as the main topic of this educational project because of its value as a strong unifying theme in natural sciences, especially relevant for developing "botanical literacy" (Uno, 2009). With the help of a small competitive grant from the Italian Ministry of Education, we set up a permanent exhibition with interpretive panels that place the phylogenesis of photosynthetic organisms in the general context of the changes that occurred during the evolution of planet Earth. Additional panels briefly trace the debate on biological evolution (from Linnaeus' immutable species to Darwin's concept of variation and selection), define the framework of evolutionary biology, and discuss the basics of molecular systematics.



Since the very beginning of our project, we decided to include interactive computer games within the exhibition as a way of reinforcing key messages to visitors. However, we designed the games as stand-alone elements, so that they could also be used outside of the exhibition context. After several attempts, three games were produced. The first game was titled "The time machine" (in Italian, "La macchina del tempo") because it involves travelling back in time to see plants from past ages. Each level starts with a question that introduces Cyanobacteria, Eukaryotic Algae, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms respectively. We did consider whether the addition of many algal taxa into the "Eukaryotic Algae" category would be too much, but in the end, we included these for the sake of clarity. After selecting one of the choices, the player travels to the desired geological era, going through the animation of a "time-tunnel", where tabs with the names and symbols of the six major groups of plants considered in the game are shown on repeat. One of the main challenges encountered by many Botany students is being able to remember the names of plants they have never heard of before. By repeating the names of the six groups, the players are more likely to remember them at the end of the activity, or at least the names become more familiar. Each activity is set in a scenario showing the main features of each geological era, and where possible the most representative animals of that time. Small animations and sound effects help to attract the attention of the player.

The graphic part of the games required careful consideration. Among the different possibilities, we opted for a cartoon-like layout to make the game more appealing for kids. The activities vary for each level, but they are all based on a "drag and drop" mechanism. After being instructed on the purpose of the activity, the player clicks on one detail (picture, name) and drags it to the right place on the screen. In case of error, the detail bounces back to its initial position, otherwise it sticks where the player placed it. For example, this mechanism is used in one level (Cyanobacteria) to discriminate between planktonic and benthic species, or in another one to classify three Bryophytes belonging to liverworts, hornworts, and mosses, respectively. After completing each level, a general description of each group appears on the screen. Completing all six levels opens the way to a seventh one: The Future. We tried to imagine what direction plant evolution may have taken, 250 million years from now, suggesting the possibility that some plants will develop the capability of metabolizing plastics and other man-made pollutants. The game is aimed at primary school kids, but it is also suitable for undergraduates studying Natural Sciences and Environmental Sciences as a tool to learn basic information about the diversity of the plant lineage.

← Panels describing Earth evolution are reproduced (with permission) from the Paleomap Project by Christopher Scotese (www.scotese.com" www.scotese.com) ©Mario De Tullio

## *"An enjoyable, yet effective way to approach complex topics"* High school student, 16 yo



↑ One level of the quiz game (Game 2) solved Design: Mario De Tullio, Pooya srl.



↑ The ABC model of flower development as described in Game 3 Design: Mario De Tullio, Pooya srl.

*"I liked The Time Machine, because I could see plants I have never heard of before"* Primary school kid, 10 yo

"The games offered a helpful visual feedback that really worked especially in on-line classes" Giulia, 19 yo, 1st-year University student



The second game, **Biodiversity and plant evolution** follows the format of a quiz show. The player reads the description of a plant, and selects the corresponding picture and scientific name. The six levels correspond to the same plant groups considered in the first game. The game is designed for middle school kids, and anyone else interested in plant trivia.

We also designed a third game, **Gene expression and floral morphology**. By regulating the expression of genes involved in the determination of flower shape (ABC model), the player interacts with the development of the *Arabidopsis* flower. The four whorls of the *Brassicaceae* flower in wild type plants (sepals, petals, stamens, and carpels) are described. The player is then asked to observe some mutants with unusual flowers. In the next level, the player has a choice to switch three genes (class A, B and C) on and off, and see the sketch of the phenotype resulting from the expression of the genes chosen. This game, which requires some basic understanding about gene expression, is designed for high school students/undergraduates.

The efficacy of the three games has been tested with many visitors, mainly school children and their teachers. Most of them are positively surprised: the smile we have observed on their faces when they use the games is the best reward for our efforts.

The games proved especially useful in times of distance learning, during the recent viral pandemic that, in Italy and many other countries, prevented in person classes from taking place. Botany classes for first-year students in Natural Sciences usually include, among other activities, a visit to our Botanic Garden to provide an overview of plant diversity, and a lab activity to learn about flower morphology. Those activities were replaced with on-line classes, using games 1 and 3, respectively. Each game session involved 80-90 students. The majority of the students we interviewed very much appreciated our games as teaching tools. In particular, the "visual feedback" they received whilst using the games helped them in their learning process. Of course, the games are not a substitute for contact with living organisms, but they can still provide a complementary approach.

The debate on the use of educational (serious) computer games is growing (Riopel *et al.*, 2019), and our experience confirms their usefulness in delivering effective science communication. We are now planning to update the games that have been produced, and to develop new ones on different aspects of plant science. The Italian version of the games is available at www.botanicalconnections.it

← The time machine: the game begins Graphic design; Mario De Tullio, Pooya srl.



↑ Kids visiting our exhibition are instructed on the use of our games ©Giovanni Signorile

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