FAIRCHILD
TROPICAL BOTANIC GARDEN

THE FAIRCHILD CHALLENGE®
Changing the way we understand and live with nature

The Fairchild Challenge is our award-winning, interdisciplinary, environmental science competition designed to engage students of diverse interests, abilities, talents and backgrounds to explore the natural world. The program has been recognized as a benchmark for exceptional STEM education and for empowering PreK – 12th grade students to become the next generation of scientists, researchers, educated voters, policy makers, and environmentally-minded citizens.

The Fairchild Challenge is made possible by the generous support of the Batchelor Foundation.

The Batchelor Foundation

Middle School Challenges

Challenge 1: Botanical Breakthrough

Challenge 2: Connect to Protect – My Story

Challenge 3: Growing Beyond Earth

Challenge 4: Green Cuisine – Cooking Show

Challenge 5: Green Treasures – Fairchild's Pharmacy

Challenge 6: Shade Our Schools – Leaves are Cool!

THE FAIRCHILD CHALLENGE®

Changing the way we understand and live with nature

Challenge 1

Botanical Breakthrough

Nature can be regarded as the most profound inventor ever known. **In response to the ever-changing environment, living organisms have evolved and adapted their form and function.** To unlock solutions to modern problems, humans are inspired by, learn from and emulate nature's materials, structures and systems. Research an invention of which the original blueprints were based on plants and their processes. **We asked students to create an infographic explaining how natural design provided the building blocks for some of our most creative engineering feats.**

Challenge 1
Botanical Breakthrough

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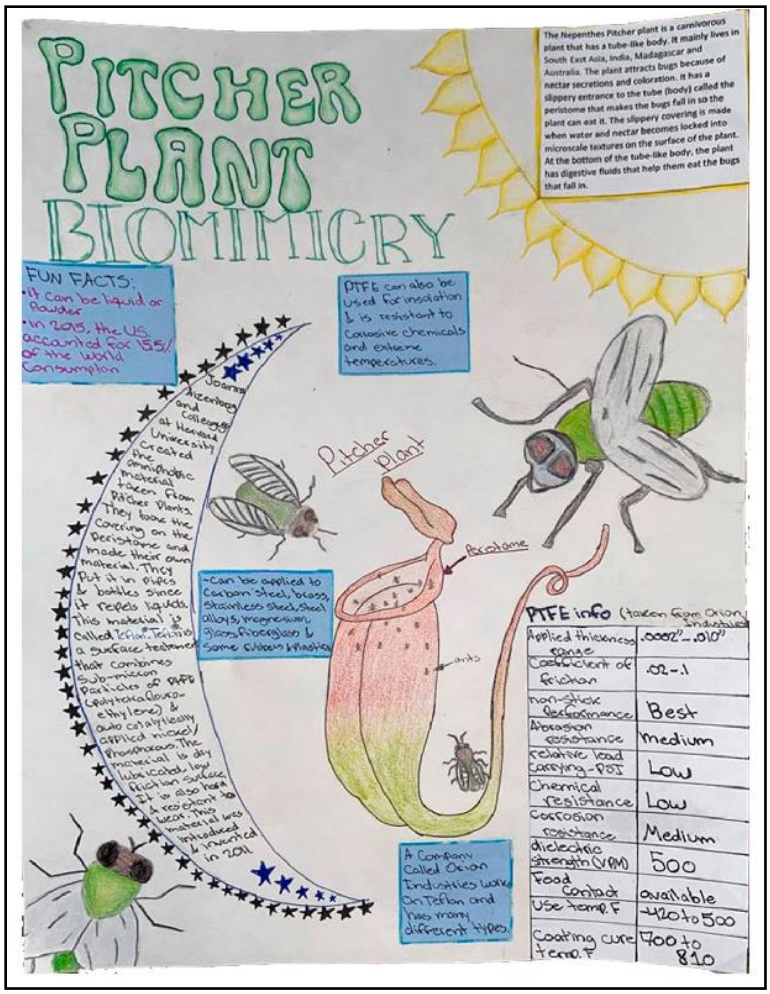
FIRST PLACE

Carolina Carbone

Aventura Waterways K-8 Center



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Challenge 1
Botanical Breakthrough

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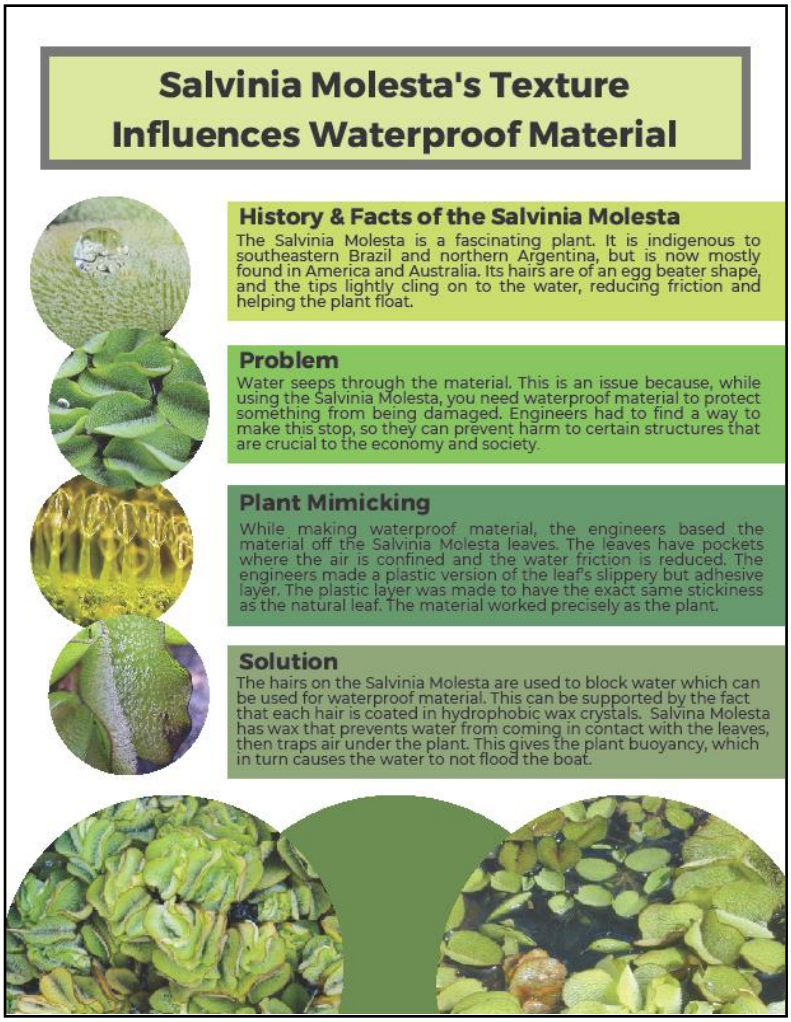
SECOND PLACE

Amelia Blanco, Anthony Garcia, Daniela Mendez, Stephen Nunez, and Jari Obando

Florida Christian School



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Challenge 1
Botanical Breakthrough

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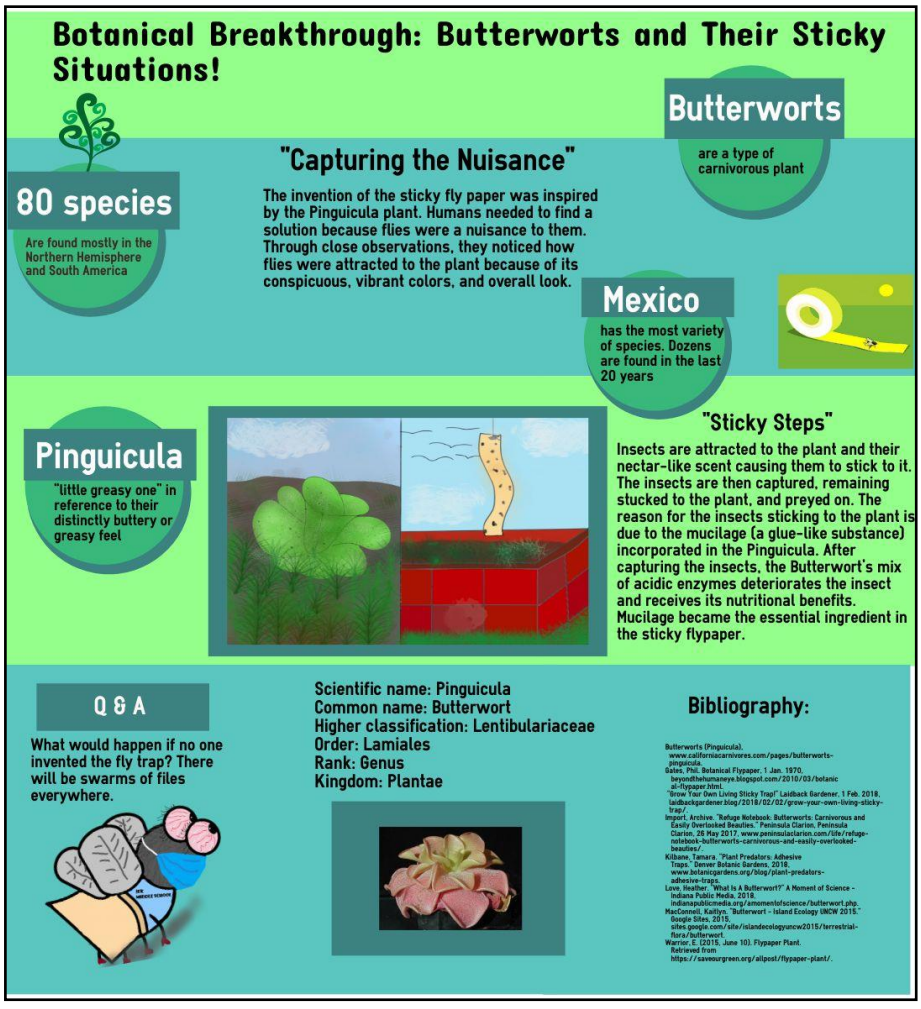
Special Merit – Novel Invention Selection

Djesly Mompremier, Reggie Mompremier, Carlatchee Noelsaint, & Kirsteen Vasquez

John F. Kennedy Middle School



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Challenge 1
Botanical Breakthrough

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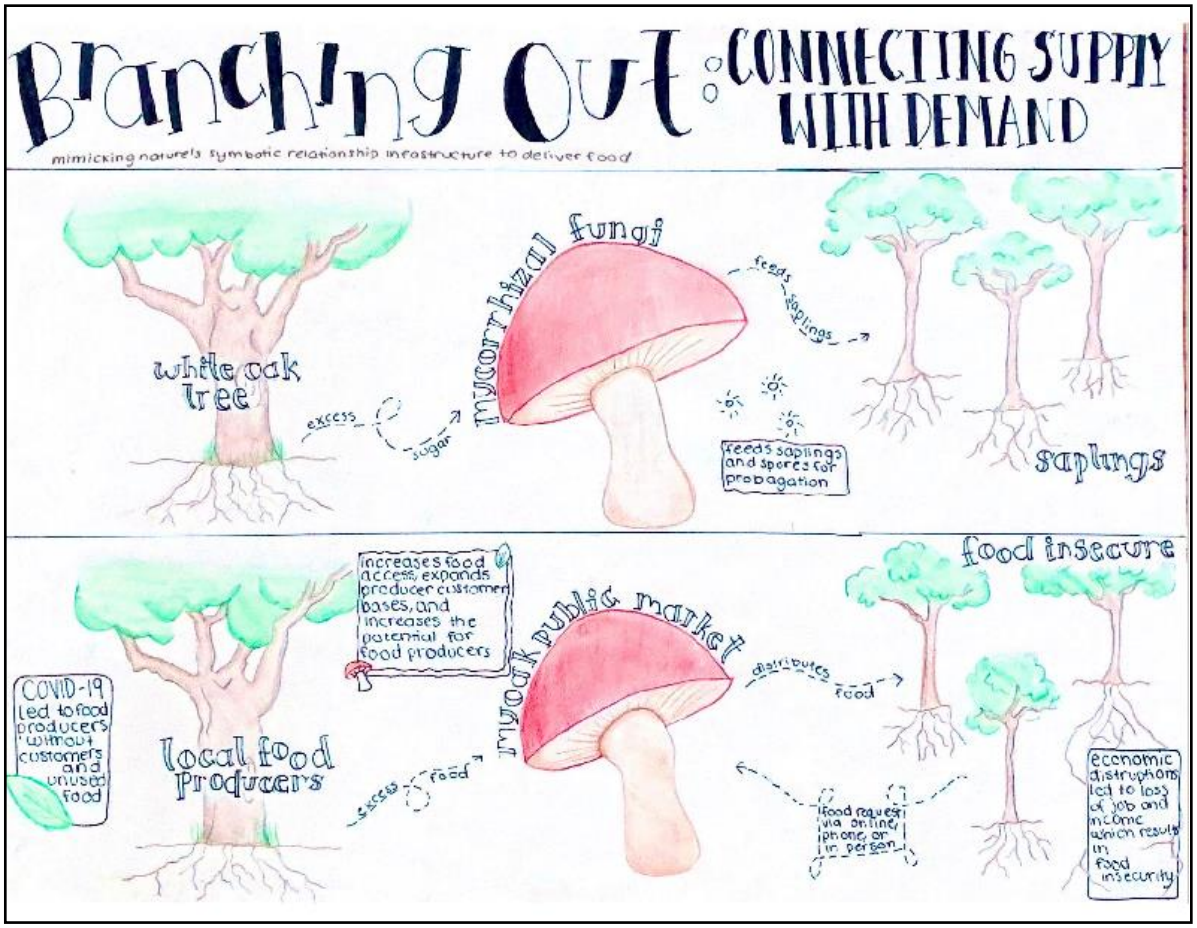
Special Merit – Artistic Ability

Kathryn Walsh

Nautilus Middle School



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Challenge 1
Botanical Breakthrough

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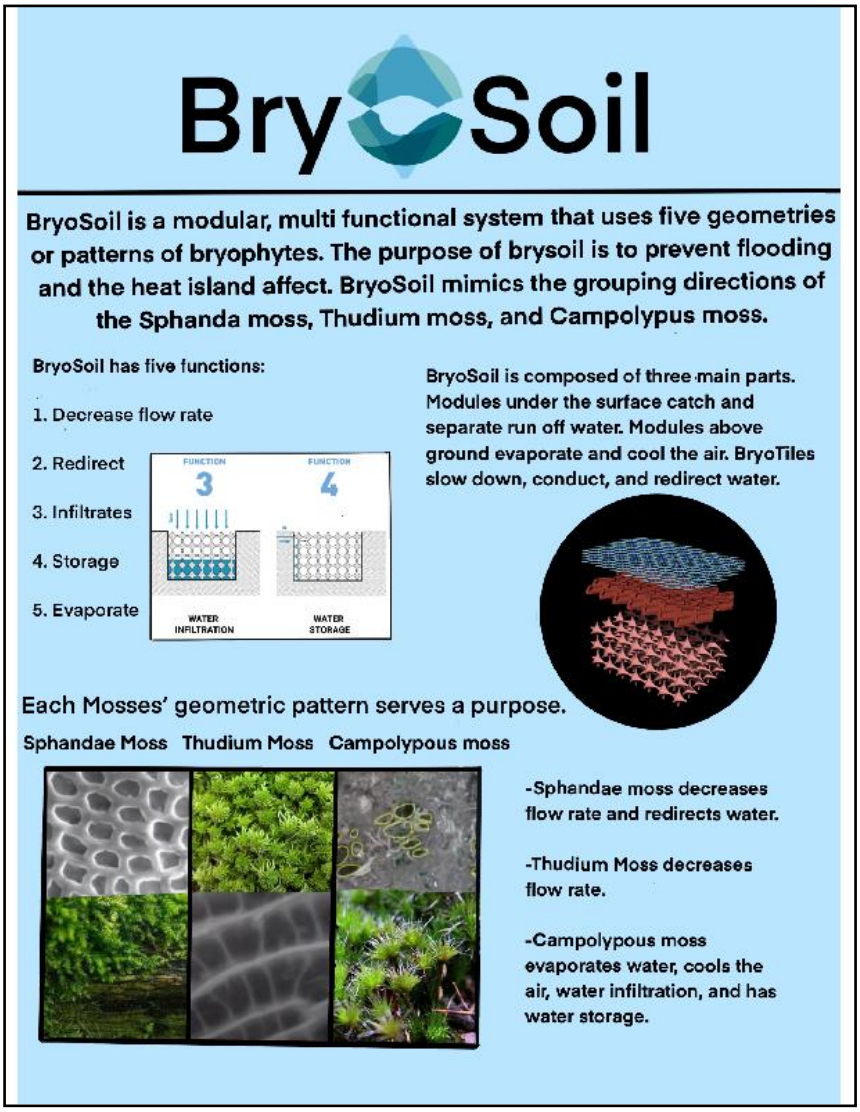
Special Merit – Unique Plant Selection

Almendra Bodan

Nautilus Middle School



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Challenge 1
Botanical Breakthrough

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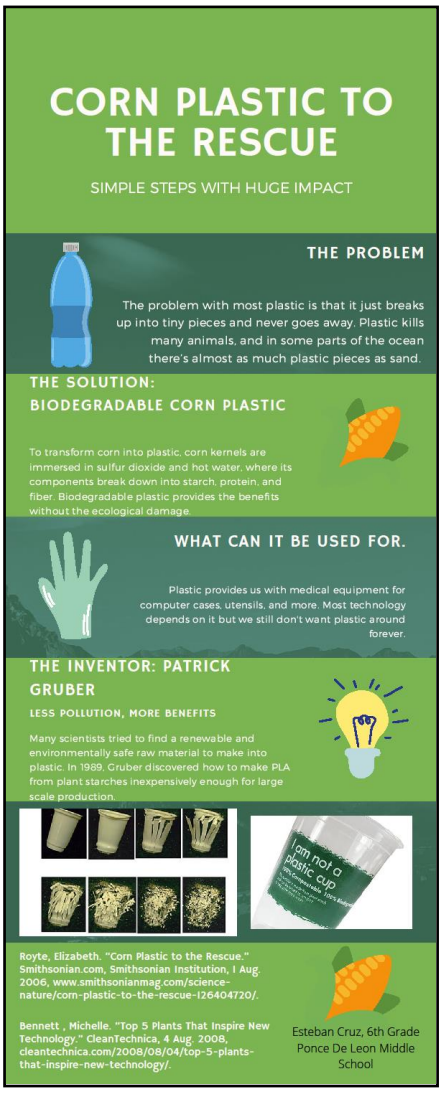
Special Merit – Concise Presentation

Esteban Cruz

Ponce De Leon Middle School



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THE FAIRCHILD CHALLENGE®

Changing the way we understand and live with nature

Challenge 2

Connect to Protect Network – My Story

Less than 2% of the pine rocklands remain outside of Everglades National Park making **this natural community one of the most globally imperiled ecosystems**. Much of what remains occurs today exists as only fragmented parcels across Miami and The Keys. **Fairchild's own Connect to Protect Network encourages families, schools and local businesses to plant pine rockland gardens to increase the probability of visits of seed dispersers and pollinators**. The goal of this conservation program is to improve genetic health of plant species by connecting these remaining isolated patches across urban areas. **We asked students to write a short story about their experience in South Florida that features the pine rockland ecosystem.**

Challenge 2
Connect to Protect Network
My Story

THE FAIRCHILD CHALLENGE®
Changing the way we understand and live with nature

FIRST PLACE

Kristian Abreu

Richmond Heights Middle School

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Challenge 2
Connect to Protect Network
My Story

THE FAIRCHILD CHALLENGE®
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SECOND PLACE

Kristopher Rodriguez

Advanced Achievers Academy

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Challenge 2
Connect to Protect Network
My Story

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Special Merit – Environmental Advocacy

Emily Cruz

Advanced Achievers Academy

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Challenge 2
Connect to Protect Network
My Story

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Special Merit – Most Imaginative

Carlatchee Noelsaint

John F. Kennedy Middle School

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Challenge 2
Connect to Protect Network
My Story

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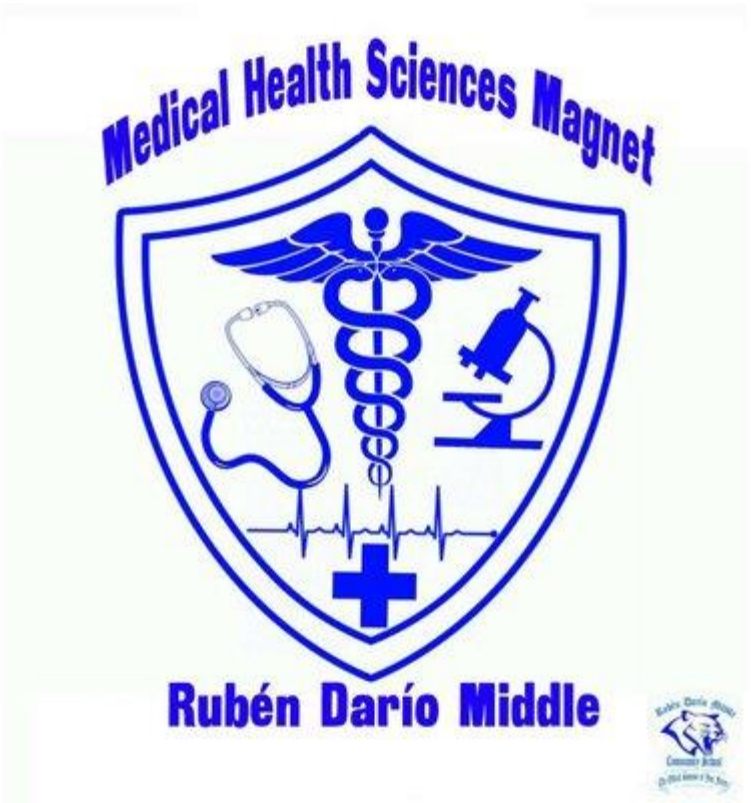
Special Merit – Educational Content

Patrick Orga

Ruben Dario Middle School



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Challenge 2
Connect to Protect Network
My Story

THE FAIRCHILD CHALLENGE®
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Special Merit – Most Captivating

Emma Delpozo

Riviera Middle School

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Challenge 2
Connect to Protect Network
My Story

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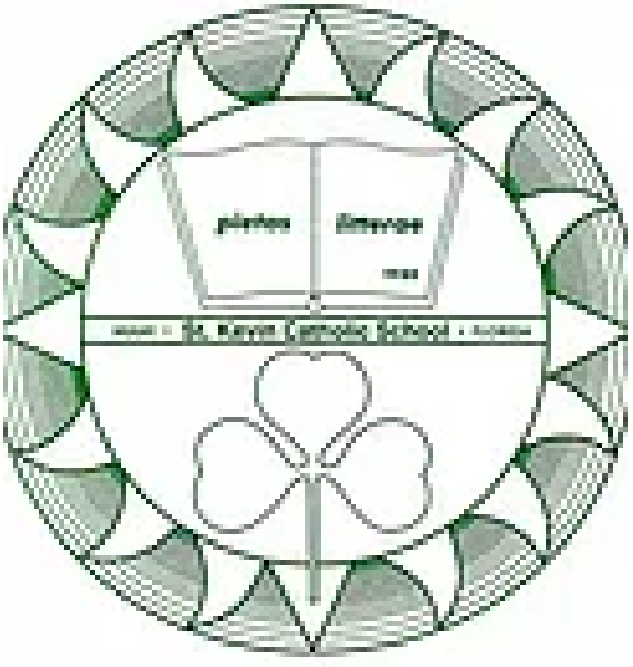
Special Merit – Descriptive Narrative

Elizabeth Adan and Sophia Setien

St. Kevin Catholic School



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THE FAIRCHILD CHALLENGE®

Changing the way we understand and live with nature

Challenge 3

Growing Beyond Earth

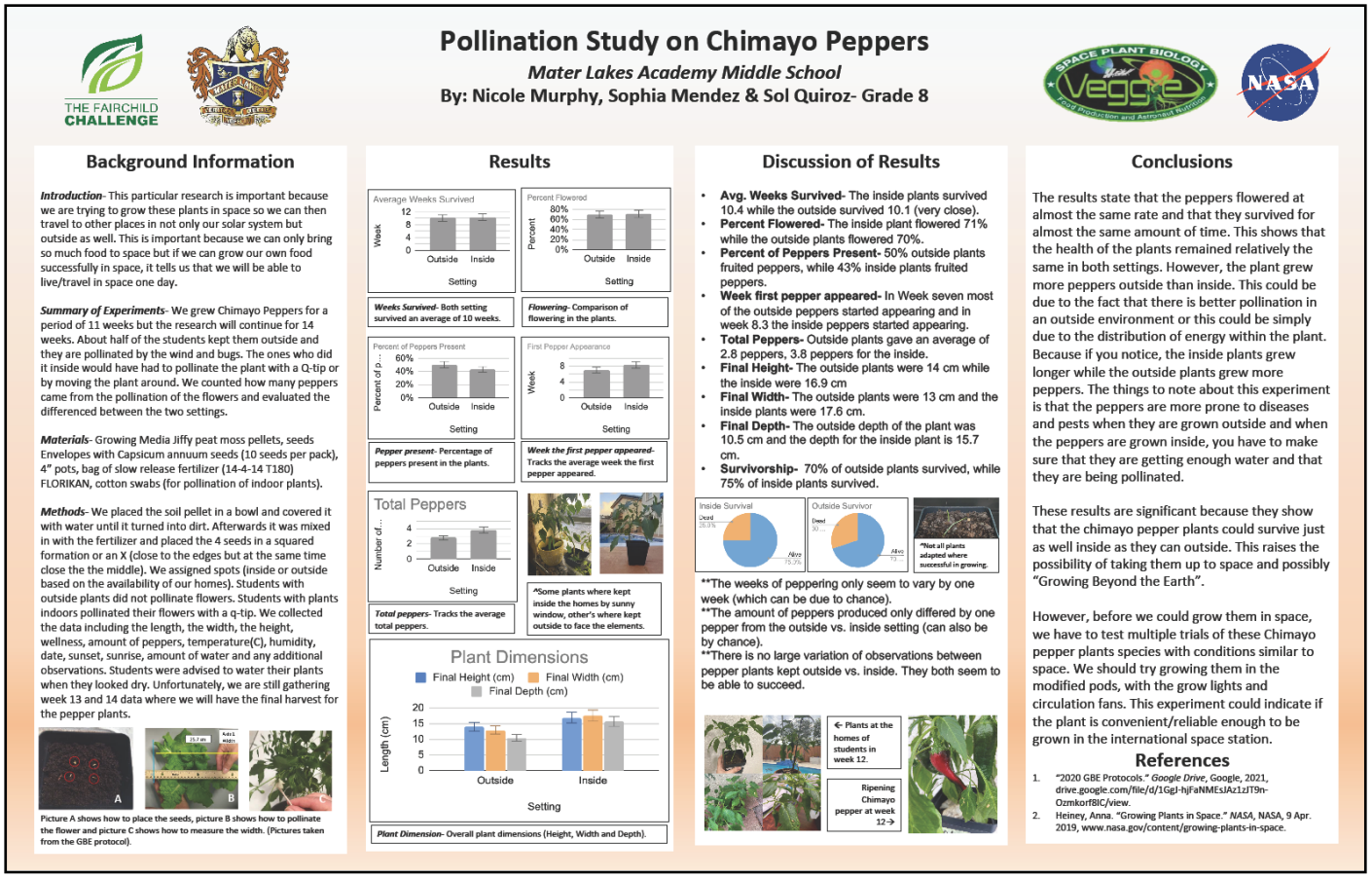
Humans have never been more determined to explore the universe, however reaching and settling new planets is still an incredible challenge with several hurdles to overcome. **One of the biggest challenges will be providing fresh produce for astronauts during long distance space travel.** For the past 5 years, your research has brought NASA closer to solving that problem and has supported some of the important components of growing plants in space. This year, **students will test different pollination methods with peppers by growing them at home or in the classroom.**

Challenge 3
Growing Beyond Earth

THE FAIRCHILD CHALLENGE®
Changing the way we understand and live with nature

FIRST PLACE

Mater Lakes Academy Middle School



Pollination Study on Chimayo Peppers

Mater Lakes Academy Middle School

By: Nicole Murphy, Sophia Mendez & Sol Quiroz- Grade 8

Background Information

Introduction- This particular research is important because we are trying to grow these plants in space so we can then travel to other places in not only our solar system but outside as well. This is important because we can only bring so much food to space but if we can grow our own food successfully in space, it tells us that we will be able to live/travel in space one day.

Summary of Experiments- We grew Chimayo Peppers for a period of 11 weeks but the research will continue for 14 weeks. About half of the students kept them outside and they are pollinated by the wind and bugs. The ones who did it inside would have had to pollinate the plant with a Q-tip or by moving the plant around. We counted how many peppers came from the pollination of the flowers and evaluated the differenced between the two settings.

Materials- Growing Media Jiffy peat moss pellets, seeds Envelopes with Capsicum annuum seeds (10 seeds per pack), 4" pots, bag of slow release fertilizer (14-4-14 T180) FLORIKAN, cotton swabs (for pollination of indoor plants).

Methods- We placed the soil pellet in a bowl and covered it with water until it turned into dirt. Afterwards it was mixed in with the fertilizer and placed the 4 seeds in a squared formation or an X (close to the edges but at the same time close the the middle). We assigned spots (inside or outside based on the availability of our homes). Students with outside plants did not pollinate flowers. Students with plants indoors pollinated their flowers with a q-tip. We collected the data including the length, the width, the height, wellness, amount of peppers, temperature(C), humidity, date, sunset, sunrise, amount of water and any additional observations. Students were advised to water their plants when they looked dry. Unfortunately, we are still gathering week 13 and 14 data where we will have the final harvest for the pepper plants.

Picture A shows how to place the seeds, picture B shows how to pollinate the flower and picture C shows how to measure the width. (Pictures taken from the GBE protocol).

Results

Weeks Survived- Both setting survived an average of 10 weeks.

Flowering- Comparison of flowering in the plants.

Pepper present- Percentage of peppers present in the plants.

Week the first pepper appeared- Tracks the average week the first pepper appeared.

Total peppers- Tracks the average total peppers.

^Some plants where kept inside the homes by sunny window, other's where kept outside to face the elements.

Plant Dimension- Overall plant dimensions (Height, Width and Depth).

Discussion of Results

- **Avg. Weeks Survived-** The inside plants survived 10.4 while the outside survived 10.1 (very close).
- **Percent Flowered-** The inside plant flowered 71% while the outside plants flowered 70%.
- **Percent of Peppers Present-** 50% outside plants fruited peppers, while 43% inside plants fruited peppers.
- **Week first pepper appeared-** In Week seven most of the outside peppers started appearing and in week 8.3 the inside peppers started appearing.
- **Total Peppers-** Outside plants gave an average of 2.8 peppers, 3.8 peppers for the inside.
- **Final Height-** The outside plants were 14 cm while the inside were 16.9 cm
- **Final Width-** The outside plants were 13 cm and the inside plants were 17.6 cm.
- **Final Depth-** The outside depth of the plant was 10.5 cm and the depth for the inside plant is 15.7 cm.
- **Survivorship-** 70% of outside plants survived, while 75% of inside plants survived.

*Not all plants adapted where successful in growing.

**The weeks of peppering only seem to vary by one week (which can be due to chance).
**The amount of peppers produced only differed by one pepper from the outside vs. inside setting (can also be by chance).
**There is no large variation of observations between pepper plants kept outside vs. inside. They both seem to be able to succeed.

← Plants at the homes of students in week 12.

Ripening Chimayo pepper at week 12→

Conclusions

The results state that the peppers flowered at almost the same rate and that they survived for almost the same amount of time. This shows that the health of the plants remained relatively the same in both settings. However, the plant grew more peppers outside than inside. This could be due to the fact that there is better pollination in an outside environment or this could be simply due to the distribution of energy within the plant. Because if you notice, the inside plants grew longer while the outside plants grew more peppers. The things to note about this experiment is that the peppers are more prone to diseases and pests when they are grown outside and when the peppers are grown inside, you have to make sure that they are getting enough water and that they are being pollinated.

These results are significant because they show that the chimayo pepper plants could survive just as well inside as they can outside. This raises the possibility of taking them up to space and possibly "Growing Beyond the Earth".

However, before we could grow them in space, we have to test multiple trials of these Chimayo pepper plants species with conditions similar to space. We should try growing them in the modified pods, with the grow lights and circulation fans. This experiment could indicate if the plant is convenient/reliable enough to be grown in the international space station.

References

1. "2020 GBE Protocols." *Google Drive*, Google, 2021, drive.google.com/file/d/1GgJ-hjFaNMEsJAz1zJT9n-Ozmkorf8IC/view.
2. Heiney, Anna. "Growing Plants in Space." *NASA*, NASA, 9 Apr. 2019, www.nasa.gov/content/growing-plants-in-space.

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Challenge 3
Growing Beyond Earth

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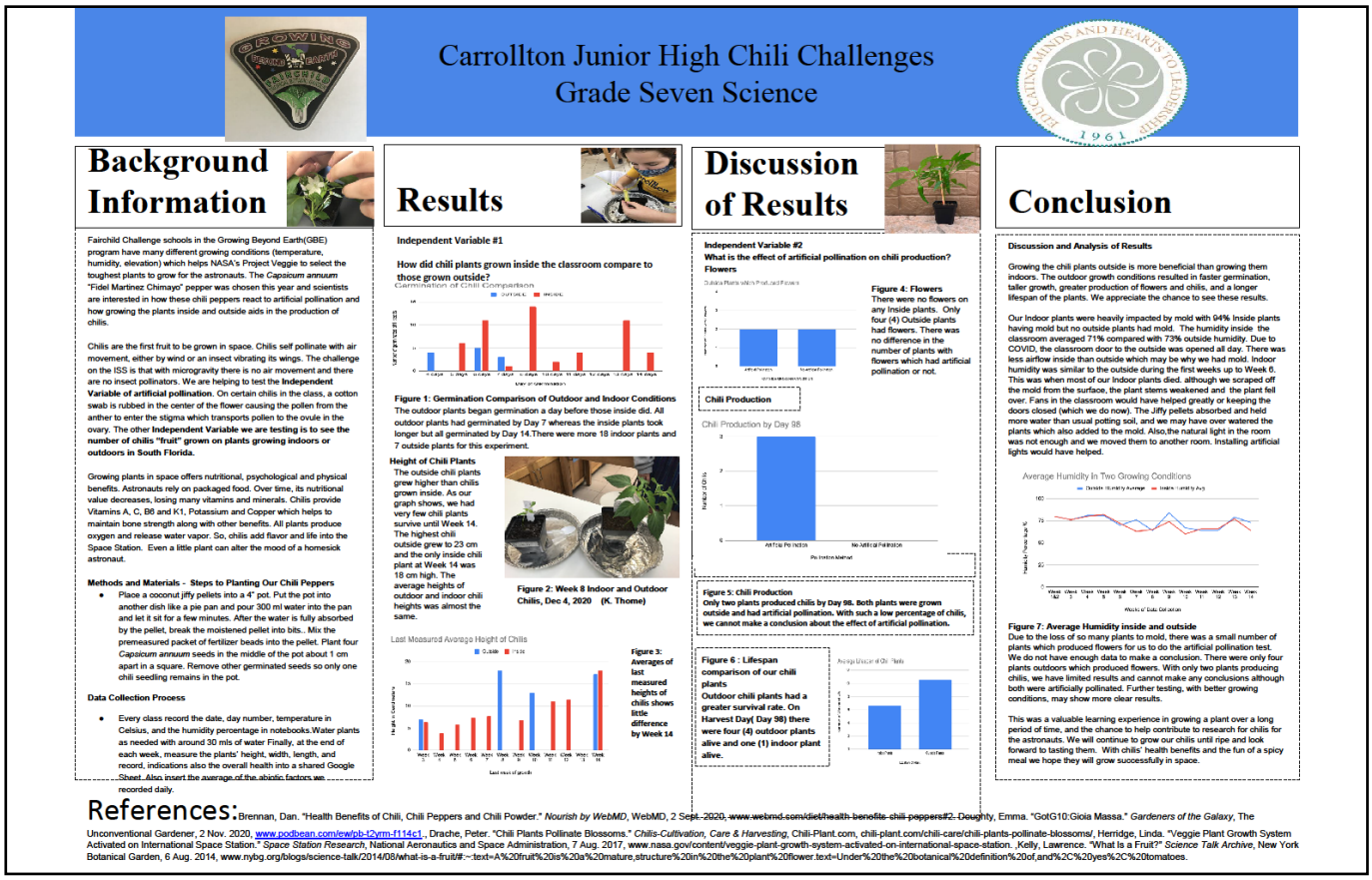
SECOND PLACE

Carrollton School of the Sacred Heart



Carrollton Junior High Chili Challenges
Grade Seven Science

Background Information

Fairchild Challenge schools in the Growing Beyond Earth(GBE) program have many different growing conditions (temperature, humidity, elevation) which helps NASA's Project Veggie to select the toughest plants to grow for the astronauts. The *Capsicum annuum* "Fidel Martinez Chimayo" pepper was chosen this year and scientists are interested in how these chili peppers react to artificial pollination and how growing the plants inside and outside aids in the production of chilis.

Chilis are the first fruit to be grown in space. Chilis self pollinate with air movement, either by wind or an insect vibrating its wings. The challenge on the ISS is that with microgravity there is no air movement and there are no insect pollinators. We are helping to test the **Independent Variable of artificial pollination**. On certain chilis in the class, a cotton swab is rubbed in the center of the flower causing the pollen from the anther to enter the stigma which transports pollen to the ovule in the ovary. The other **Independent Variable we are testing is to see the number of chilis "fruit" grown on plants growing indoors or outdoors in South Florida.**

Growing plants in space offers nutritional, psychological and physical benefits. Astronauts rely on packaged food. Over time, its nutritional value decreases, losing many vitamins and minerals. Chilis provide Vitamins A, C, B6 and K1, Potassium and Copper which helps to maintain bone strength along with other benefits. All plants produce oxygen and release water vapor. So, chilis add flavor and life into the Space Station. Even a little plant can alter the mood of a homesick astronaut.

Methods and Materials - Steps to Planting Our Chili Peppers

- Place a coconut jiffy pellets into a 4" pot. Put the pot into another dish like a pie pan and pour 300 ml water into the pan and let it sit for a few minutes. After the water is fully absorbed by the pellet, break the moistened pellet into bits.. Mix the premeasured packet of fertilizer beads into the pellet. Plant four *Capsicum annuum* seeds in the middle of the pot about 1 cm apart in a square. Remove other germinated seeds so only one chili seedling remains in the pot.

Data Collection Process

- Every class record the date, day number, temperature in Celsius, and the humidity percentage in notebooks.Water plants as needed with around 30 mls of water Finally, at the end of each week, measure the plants' height, width, length, and record, indications also the overall health into a shared Google Sheet. Also insert the average of the abiotic factors we recorded daily.

Results

Independent Variable #1

How did chili plants grown inside the classroom compare to those grown outside?

Germination of Chili Comparison

Figure 1: Germination Comparison of Outdoor and Indoor Conditions
The outdoor plants began germination a day before those inside did. All outdoor plants had germinated by Day 7 whereas the inside plants took longer but all germinated by Day 14.There were more 18 indoor plants and 7 outside plants for this experiment.

Height of Chili Plants
The outside chili plants grew higher than chilis grown inside. As our graph shows, we had very few chili plants survive until Week 14. The highest chili outside grew to 23 cm and the only inside chili plant at Week 14 was 18 cm high. The average heights of outdoor and indoor chili heights was almost the same.

Figure 2: Week 8 Indoor and Outdoor Chilis, Dec 4, 2020 (K. Thome)

Last Measured Average Height of Chilis

Figure 3: Averages of last measured heights of chilis shows little difference by Week 14

Discussion of Results

Independent Variable #2
What is the effect of artificial pollination on chili production?
Flowers

Figure 4: Flowers
There were no flowers on any Inside plants. Only four (4) Outside plants had flowers. There was no difference in the number of plants with flowers which had artificial pollination or not.

Chili Production

Chili Production by Day 98

Figure 5: Chili Production
Only two plants produced chilis by Day 98. Both plants were grown outside and had artificial pollination. With such a low percentage of chilis, we cannot make a conclusion about the effect of artificial pollination.

Figure 6 : Lifespan comparison of our chili plants
Outdoor chili plants had a greater survival rate. On Harvest Day(Day 98) there were four (4) outdoor plants alive and one (1) indoor plant alive.

Conclusion

Discussion and Analysis of Results

Growing the chili plants outside is more beneficial than growing them indoors. The outdoor growth conditions resulted in faster germination, taller growth, greater production of flowers and chilis, and a longer lifespan of the plants. We appreciate the chance to see these results.

Our Indoor plants were heavily impacted by mold with 94% Inside plants having mold but no outside plants had mold. The humidity inside the classroom averaged 71% compared with 73% outside humidity. Due to COVID, the classroom door to the outside was opened all day. There was less airflow inside than outside which may be why we had mold. Indoor humidity was similar to the outside during the first weeks up to Week 6. This was when most of our Indoor plants died. although we scraped off the mold from the surface, the plant stems weakened and the plant fell over. Fans in the classroom would have helped greatly or keeping the doors closed (which we do now). The Jiffy pellets absorbed and held more water than usual potting soil, and we may have over watered the plants which also added to the mold. Also,the natural light in the room was not enough and we moved them to another room. Installing artificial lights would have helped.

Average Humidity In Two Growing Conditions

Figure 7: Average Humidity inside and outside
Due to the loss of so many plants to mold, there was a small number of plants which produced flowers for us to do the artificial pollination test. We do not have enough data to make a conclusion. There were only four plants outdoors which produced flowers. With only two plants producing chilis, we have limited results and cannot make any conclusions although both were artificially pollinated. Further testing, with better growing conditions, may show more clear results.

This was a valuable learning experience in growing a plant over a long period of time, and the chance to help contribute to research for chilis for the astronauts. We will continue to grow our chilis until ripe and look forward to tasting them. With chilis' health benefits and the fun of a spicy meal we hope they will grow successfully in space.

References:

Brennan, Dan. "Health Benefits of Chili, Chili Peppers and Chili Powder." *Nourish by WebMD*, WebMD, 2 Sept. 2020, www.webmd.com/diet/health-benefits-chili-peppers#2. Doughty, Emma. "GotG10:Gioia Massa." *Gardeners of the Galaxy*, The Unconventional Gardener, 2 Nov. 2020, www.podbean.com/ew/pb-t2ym-f114c1 , Drache, Peter. "Chili Plants Pollinate Blossoms." *Chilis-Cultivation, Care & Harvesting*, Chili-Plant.com, chili-plant.com/chili-care/chili-plants-pollinate-blossoms/, Herridge, Linda. "Veggie Plant Growth System Activated on International Space Station." *Space Station Research*, National Aeronautics and Space Administration, 7 Aug. 2017, www.nasa.gov/content/veggie-plant-growth-system-activated-on-international-space-station. ,Kelly, Lawrence. "What Is a Fruit?" *Science Talk Archive*, New York Botanical Garden, 6 Aug. 2014, www.nybg.org/blogs/science-talk/2014/08/what-is-a-fruit/#:~:text=A%20fruit%20is%20a%20mature,structure%20in%20the%20plant%20flower.text=Under%20the%20botanical%20definition%20of,and%2C%20yes%2C%20tomatoes.

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Challenge 3
Growing Beyond Earth

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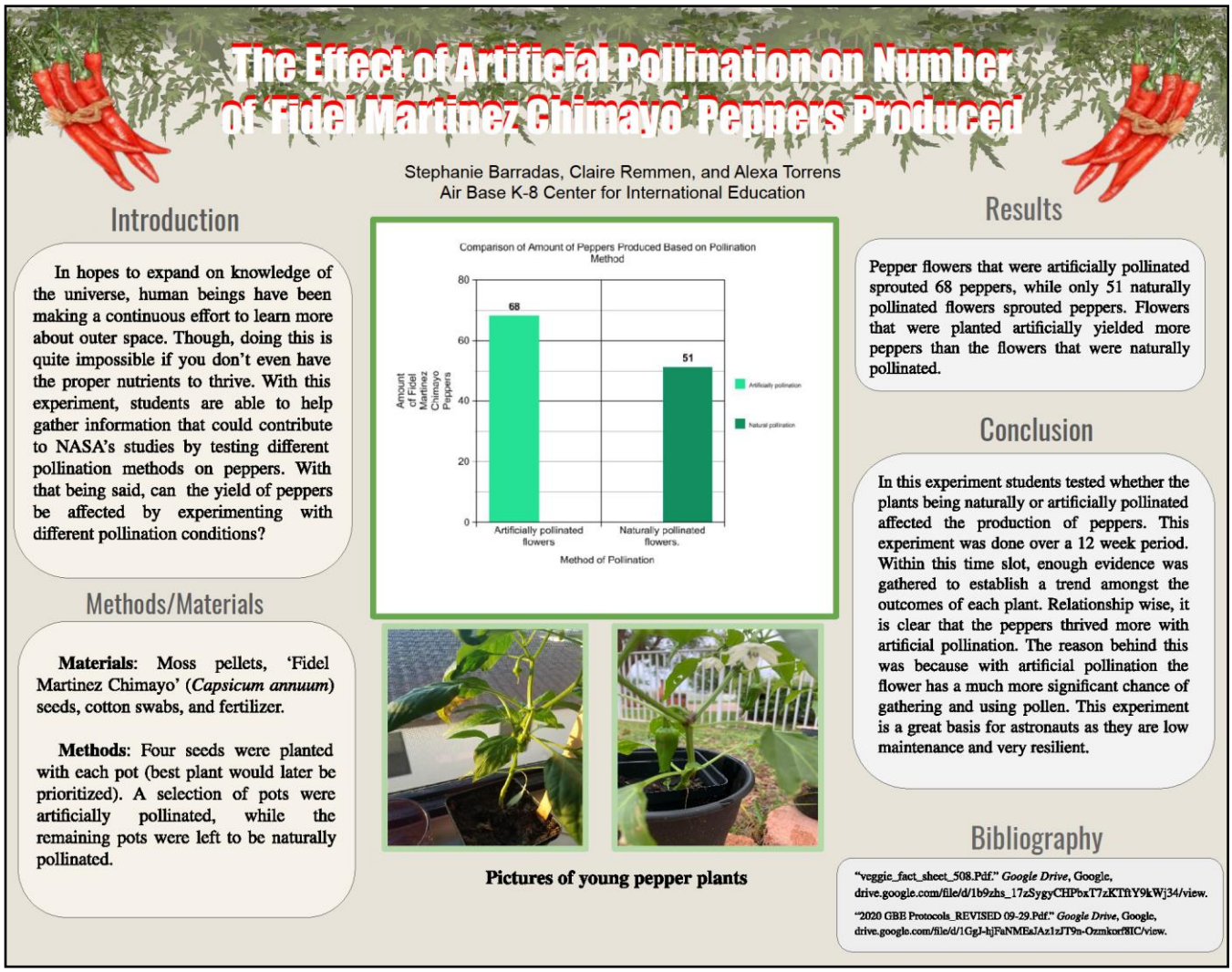
Special Merit – Clear and Concise Presentation

Air Base K-8 Center



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THE FAIRCHILD CHALLENGE®

Changing the way we understand and live with nature

Challenge 4

Green Cuisine – Cooking Show

Food brings comfort during these unprecedented times when people maintain social distancing and stay at home. **To reduce shopping trips people turn to their pantries for convenience, nutrition and delicious meals.** Staples such as rice, pasta and beans to shelf-stable condiments like vinegar, soy sauce and hot sauce can be found in the cupboard. **We asked students to create a cooking video showcasing imaginative recipes from the cupboard.**

Challenge 4
Green Cuisine
Cooking Show

THE FAIRCHILD CHALLENGE®
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FIRST PLACE

Pam Fuentes and Anna Fuentes

Vineland K-8 Center

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Challenge 4
Green Cuisine
Cooking Show

THE FAIRCHILD CHALLENGE®
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SECOND PLACE

Emily Galindo and Nestor Gandul

Rockway Middle School

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Challenge 4
Green Cuisine
Cooking Show

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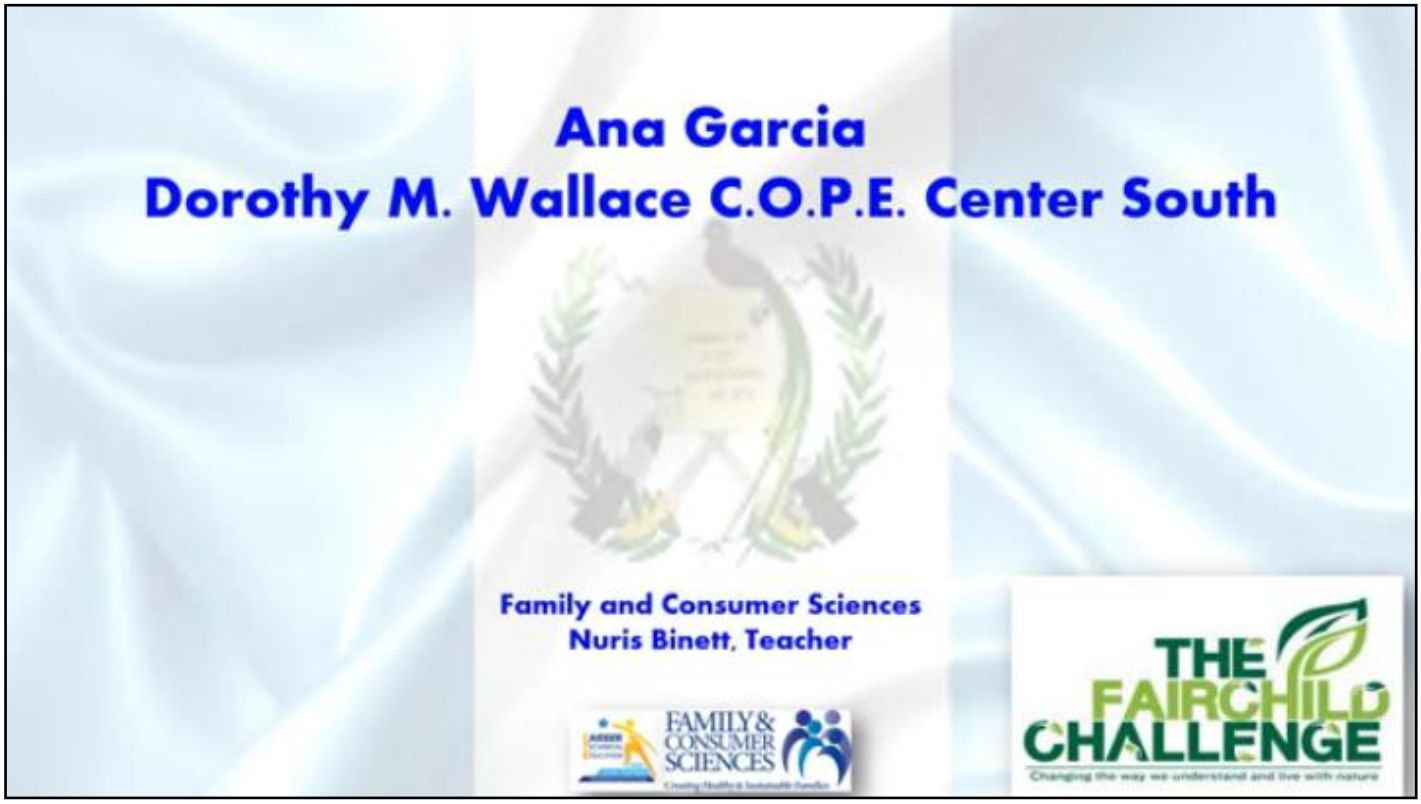
Special Merit – Best Use of Graphics

Ana Garcia

Dorothy M. Wallace COPE Center



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Challenge 4
Green Cuisine
Cooking Show

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Special Merit – Ingenious Use of Pantry Ingredients

Sofia Crespo, Selene Lettieres, Adel Adly, and Miranda Silva

Mater Grove Academy

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Challenge 4
Green Cuisine
Cooking Show

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Special Merit – Most Dynamic

Vivian Cordova, Alexa Diez-Arguelles, and Danica Argote

St. Kevin Catholic School

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THE FAIRCHILD CHALLENGE®

Changing the way we understand and live with nature

Challenge 5

Green Treasures – Fairchild's Pharmacy

Throughout the course of history people from all over the world have turned to specific plants for their healing properties many of which have been incorporated into contemporary medicine. **To date, nearly 18,000 plant species have documented medicinal uses several of which are on display at Fairchild.** These plants are not only beautiful to look at but are traditionally used to create natural remedies for the treatment of many common ailments. **Students were asked to research three of the plants on the provided list below and create a podcast describing the medicinal uses of each plant found in Fairchild's living collection**.

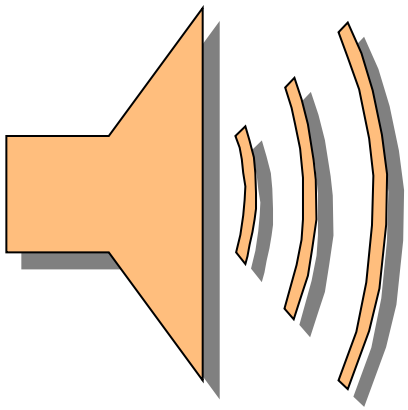
Challenge 5
Green Treasures
Fairchild's Pharmacy

THE FAIRCHILD CHALLENGE®
Changing the way we understand and live with nature

FIRST PLACE

Jan Carlos Hernandez, Dominic Hernandez, Bryan Backs, and Carlos De Armas

Hialeah Gardens Middle School



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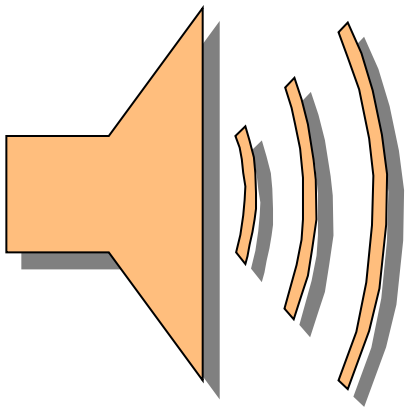
Challenge 5
Green Treasures
Fairchild's Pharmacy

THE FAIRCHILD CHALLENGE®
Changing the way we understand and live with nature

SECOND PLACE

Sophia Setien, Elizabeth Adan, and Sabrina Pernas

St. Kevin Catholic School



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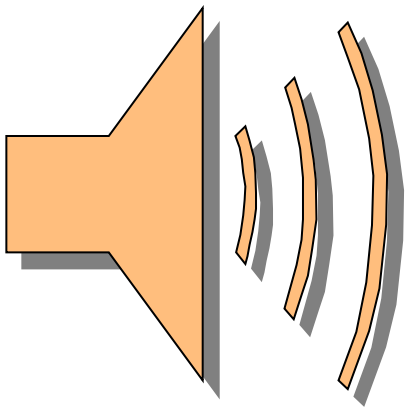
Challenge 5
Green Treasures
Fairchild's Pharmacy

THE FAIRCHILD CHALLENGE®
Changing the way we understand and live with nature

Special Merit – Unique Plant Selection

Sasha Mendez, Anthony Gonzalez, Edier Hernandez, Analia Alvarez, Marc Dorcin, Helen Ramos, Nicole Vazquez, Geeovanny Contreras, and Victoria Miranda

Advanced Achievers Academy



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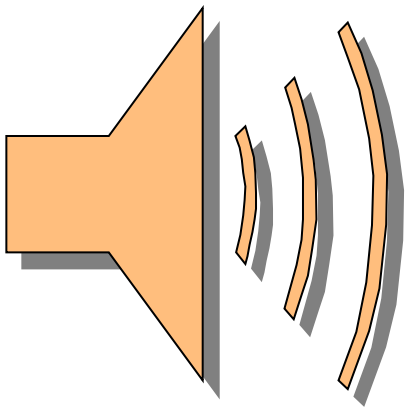
Challenge 5
Green Treasures
Fairchild's Pharmacy

THE FAIRCHILD CHALLENGE®
Changing the way we understand and live with nature

Special Merit – Educational Content

Santiago Bonilla and Alejandro Velasco

St. Bonaventure Catholic School



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THE FAIRCHILD CHALLENGE®

Changing the way we understand and live with nature

Challenge 6

Shade our School – Leaves are Cool!

Despite rising temperatures, plants may be able to use different tricks to regulate their leaf temperatures and avoid overheating. **Similar to how humans sweat to cool down, plants can use transpiration to lower their leaf temperatures.** However, as many scientists predict decreases in rainfall and increasing temperatures for many parts of the world – including much of the tropics and subtropics **– those plants that rely on transpiration to keep cool may be especially threatened by global climate change.** This year, **students helped scientists at the University of Miami to conduct a series of experiments to characterize transpiration rates across different plant species** to see which species fare best in the future. **Students** used standardized methods to collect scientific data and **created an illustrated field journal documenting their observations.**

Challenge 6
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THE FAIRCHILD CHALLENGE®
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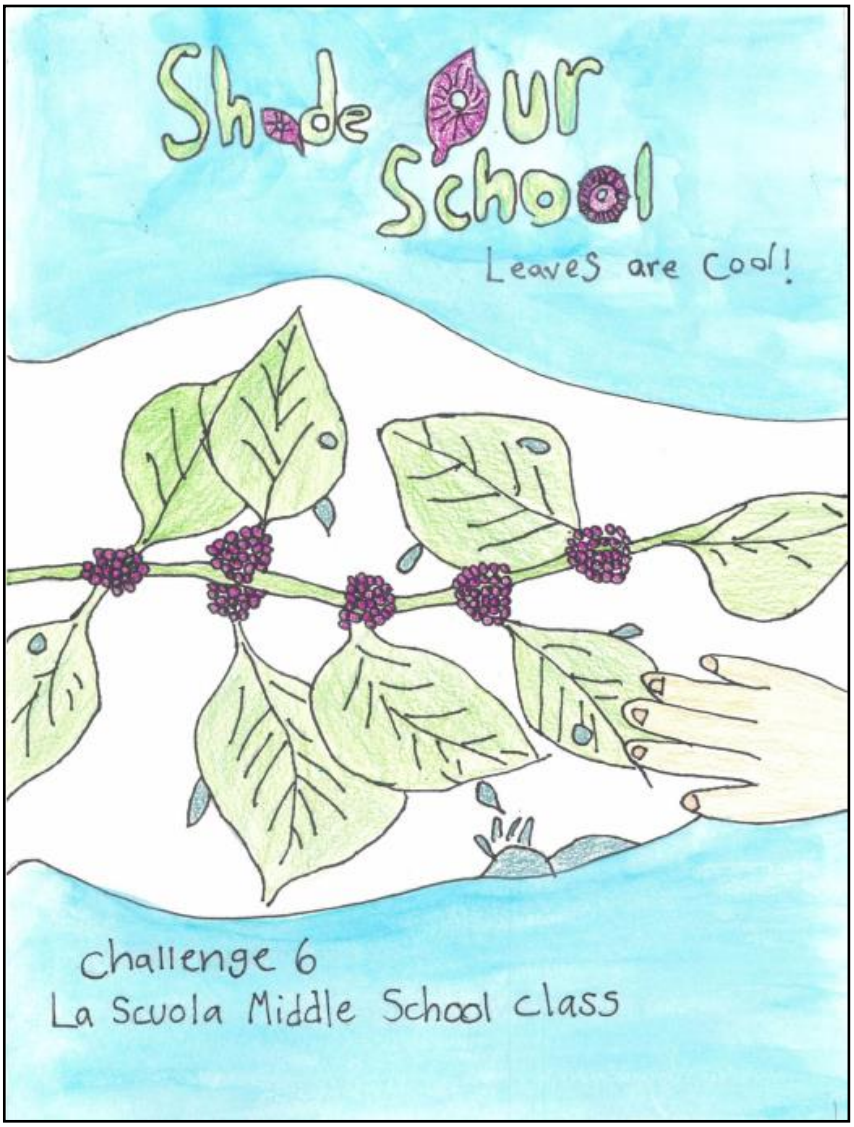
FIRST PLACE

La Scuola



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Challenge 6
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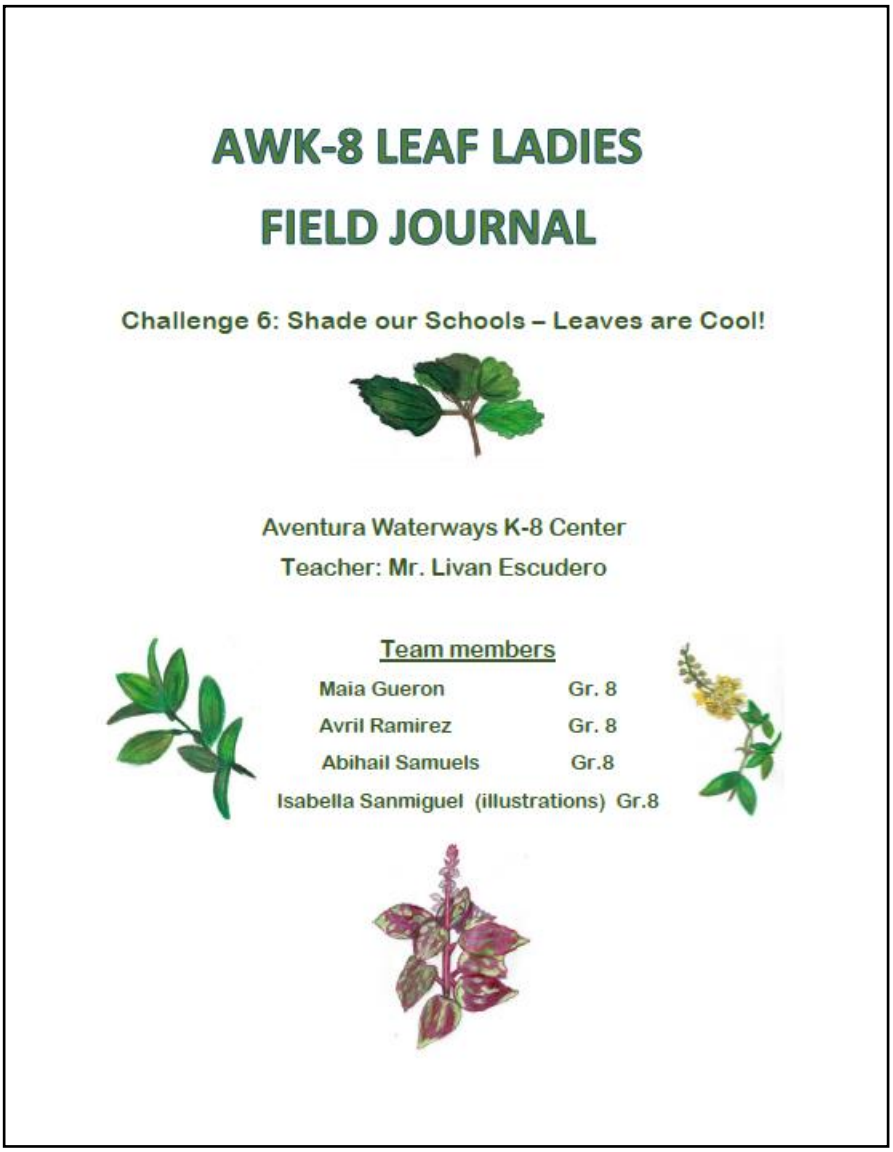
SECOND PLACE

Aventura Waterways K-8 Center



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Challenge 6
Shade our School –
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Special Merit – Depth of Research

Mater Lakes Academy Middle School

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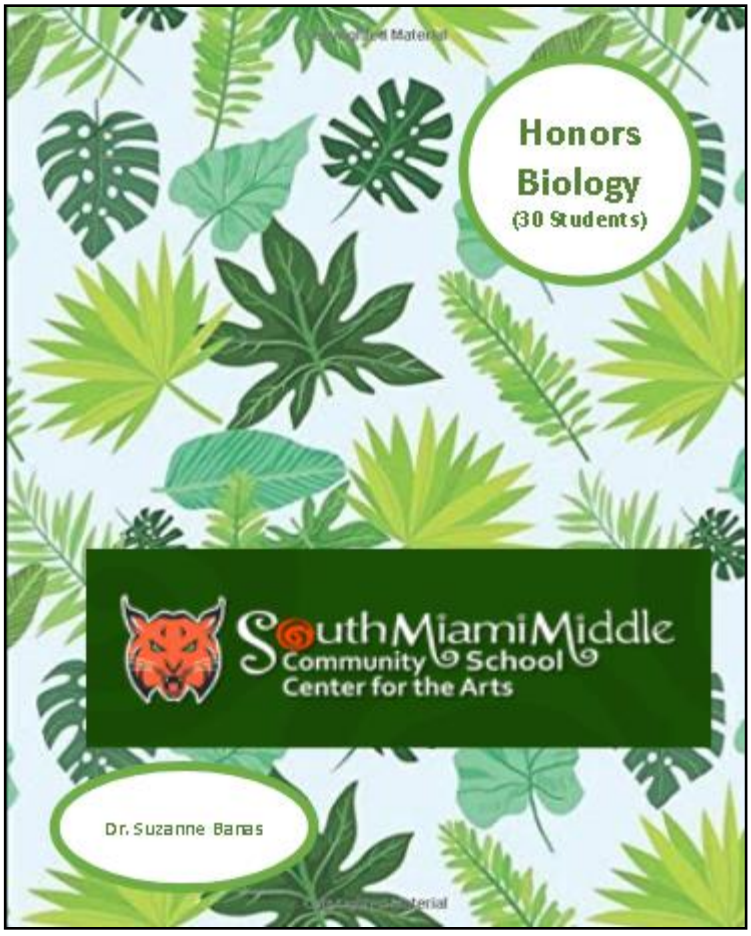
Special Merit – Relevance to Theme

South Miami Middle School



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Challenge 6
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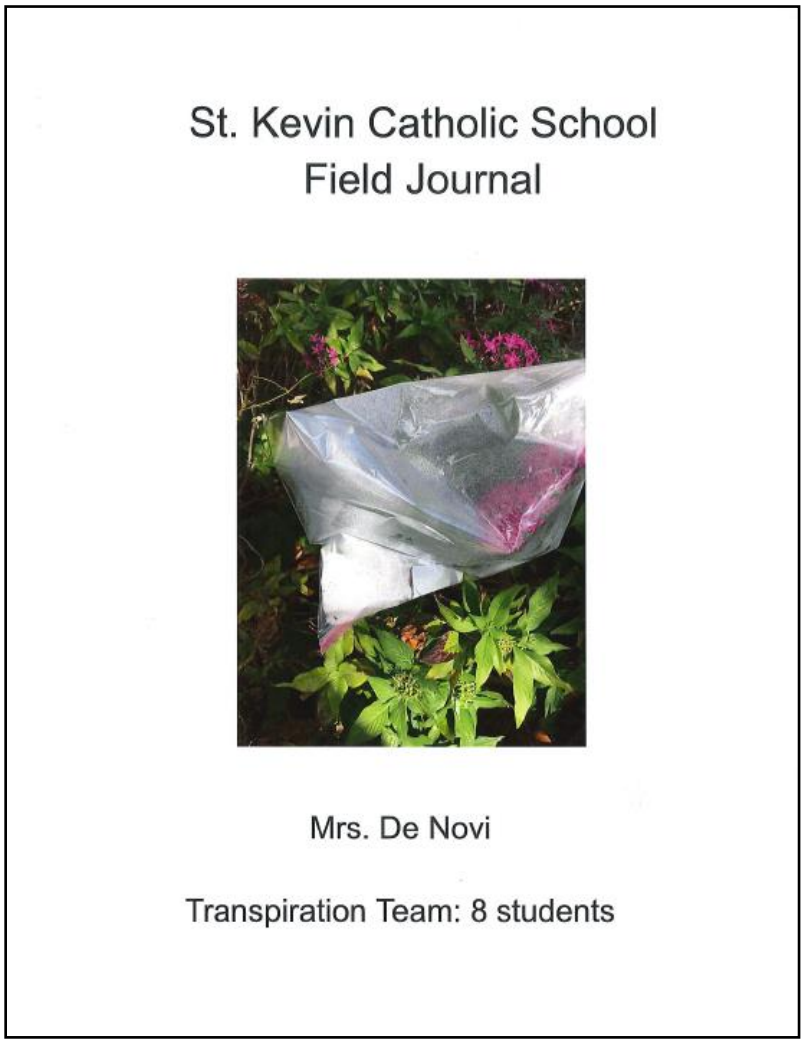
Special Merit – Artistic

St. Kevin Catholic School



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