



Ozone Gardens for the Citizen Scientist

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Virginia Living Museum



Marshall Early Learning Center



Our Lady of Mount Carmel School



Our Ozone Gardens

NASA Langley partnered with the Virginia Living Museum and two schools to create ozone bioindicator gardens for citizen scientists of all ages. The garden at the Marshall Learning Center is part of a community vegetable garden designed to teach young children where food comes from and pollution in their area, since most of the children have asthma. The Mt Carmel garden is located at a K-8 school. Different ozone sensitive and ozone tolerant species are growing and being monitored for leaf injury. In addition, CairClip ozone monitors were placed in the gardens and data are compared to ozone levels at the NASA Langley Chemistry and Physics Atmospheric Boundary Layer Experiment (CAPABLE) site in Hampton, VA. Leaf observations and plant measurements are made two to three times a week throughout the growing season.



Pictured to the right are young citizen scientists planting seeds and a NASA Intern checking the ozone monitor at the museum garden.

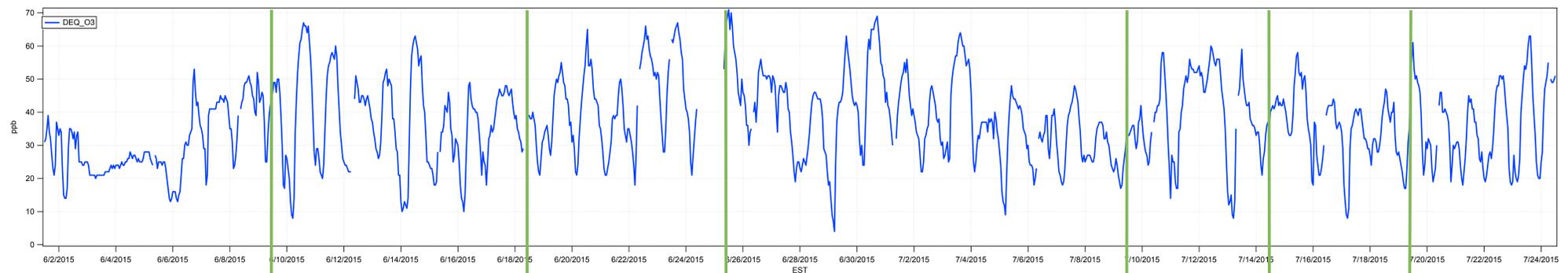
Agricultural Plants	Sensitive	Tolerant
<i>Solanum tuberosum</i> Potato	<i>La Chipper Superior</i>	
<i>Nicotiana glauca</i> Cigar Wrapper Tobacco	<i>Bel-W-3</i>	<i>Bel-B</i>
<i>Phaseolus vulgaris</i> Snap Bean	<i>S-156</i>	<i>R-331</i>

Ozone Sensitive Native Plants	
Common Milkweed	<i>Asclepias syriaca</i>
Cutleaf Coneflower	<i>Rudbeckia laciniata</i>
Black Cherry	<i>Prunus serotina</i>

Common Milkweed
Typical ozone-induced stippling
Injury Classes 1 through 6 (Left to Right) with 0, 1-6, 7-25, 26-50, 51-75, and 76-100% injury



Ozone and Leaf Stippling June- July 2015



Snap Bean Leaf Stippling Progression

Sensitive (top row) and **Tolerant** (bottom row) leaves are shown at various dates: 6/12/15, 6/19/15, 6/26/15, 7/1/15, 7/10/15, 7/15/15, 7/20/15, and 7/22/15. The images illustrate the progression of stippling and necrosis on sensitive leaves compared to tolerant ones.

Data Collection Sheets designed for Citizen Scientists of all ages visiting the museum

Age Range	Color Worksheet	WORKSHEET 1: Measuring with Blocks	WORKSHEET 2: What's in the Garden?	WORKSHEET 3: Taking Measurements	WORKSHEET 4: Ozone in the Garden	WORKSHEET 5: Ozone and Leaves	WORKSHEET 6: Type of Injury	WORKSHEET 7: A Look At Stippling	WORKSHEET 8: A Look At Stippling
1-3	Green	How many blocks fall in this plant?	Plant your favorite plants in the garden.	Counting to take measurements	Determining signs of ozone injury on plants	Determining signs of ozone injury on leaves	Determining the type of injury based on the garden	This is a sample of ozone injury on leaves from the garden.	This is a sample of ozone injury on leaves from the garden.
3-5	Yellow	1. How many blocks fall in this plant?	1. What is today's date?	1. Measure each plant.	1. Measure each plant.	1. What is today's date?	1. What is today's date?	1. What is today's date?	1. What is today's date?
6-8	Orange	2. How many blocks fall in this plant?	2. What is the name of the plants you are growing?	2. Measure the height of each plant.	2. Measure the height of each plant.	2. How many blocks fall in this plant?	2. How many blocks fall in this plant?	2. How many blocks fall in this plant?	2. How many blocks fall in this plant?
9-10	Red	3. How many blocks fall in this plant?	3. How many blocks fall in this plant?	3. Measure the width of each plant.	3. Measure the width of each plant.	3. How many blocks fall in this plant?	3. How many blocks fall in this plant?	3. How many blocks fall in this plant?	3. How many blocks fall in this plant?
11-13	Purple	4. How many blocks fall in this plant?	4. How many blocks fall in this plant?	4. Measure the diameter of each plant.	4. Measure the diameter of each plant.	4. How many blocks fall in this plant?	4. How many blocks fall in this plant?	4. How many blocks fall in this plant?	4. How many blocks fall in this plant?
+13	Brown	5. How many blocks fall in this plant?	5. How many blocks fall in this plant?	5. Measure the circumference of each plant.	5. Measure the circumference of each plant.	5. How many blocks fall in this plant?	5. How many blocks fall in this plant?	5. How many blocks fall in this plant?	5. How many blocks fall in this plant?