

# Ozone Garden

## In a Nutshell

Ozone gardens are comprised of ozone sensitive plants such as the common milkweed or snap beans. During the growing season, these plants will show obvious signs of damage from elevated levels of ozone. High concentrations of ozone are toxic to animal and plant life especially on very hot days. Building an ozone garden provides a clear demonstration of negative impacts of ozone. There are also websites for you to post pictures and information about your garden, thus contributing to scientific research.

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## The “How To”

Ozone (O<sub>3</sub>) generally appears in one of two areas in our atmosphere: the stratosphere or upper atmosphere and the troposphere or near ground level. In the stratosphere, ozone occurs naturally and shields us from ultraviolet radiation thus making life on Earth possible. In the lower atmosphere, ozone is human-made and creates a variety of health problems and impacts animal and plant life. Ground level ozone occurs when volatile organic compounds and oxides of nitrogen from car exhaust and other emissions from industrial activities chemically react with oxygen in the presence of strong sunlight and high temperatures (above 85° F). Ozone can also be transported long distances by weather systems, so rural areas can also be affected. Scientists use [ozone gardens](#) to conduct research and educate the public on the harmful effects of ground level ozone.

[This guide](#), adopted from NASA, provides a step-by-step guide to creating your own ozone garden. The steps are similar to building a regular garden, except you use ozone sensitive plants, preferably ones native to your region.

Saint Louis University’s St. Louis Ozone Garden Project has built three gardens in the St. Louis area. The project is a partnership between Saint Louis University, the Missouri Botanical Garden, and the St. Louis Science Center.

[This implementation guide](#) explains a lot of scientific and technical knowledge behind ozone and ozone gardens. The first section provides background information on the formation of ozone air pollution and its impact on vegetation. The second section provides a general introduction to the characteristics of ozone’s induced foliar injury to the leaves of various plants and describes the scientific processes used to identify symptoms of these injuries. Finally, the third section discusses the methods used to set up ozone gardens and for submitting data on the garden.

## Planning & Zoning

Ozone gardening does not require any unique zoning requirements. Some of the ideal plants for ozone gardens include common milkweed, tall milkweed and cutleaf coneflower. These plants show signs of ozone damage easily and also grow well in St. Louis’ climate. Starting on page 19 of this [implementation guide](#), the authors explain how to start an ozone garden. The guide covers gardens as small as a plant in a pot, and as large as a full size garden.

# Dollars & Cents

The cost of the private ozone garden depends on multiple factors:

1. Variety and number of plants
2. Regular gardening costs (fertilizer, etc.)
3. Cost of measuring tools, such as magnifying glasses or yard sticks.

The cost of larger ozone gardens operated by private or public institutions come with a higher price tag. For the St. Louis ozone garden, a collaboration between St. Louis University, the Missouri Botanical Garden and The St. Louis Science Center, the costs were: \$15,000-\$25,000. This included:

1. Fence
2. Gate
3. irrigation
4. Ozone monitor

They estimate the yearly maintenance cost at \$5,000-\$15,000.

# Measuring Success

The ultimate goal of an ozone garden is to make the public aware of the dangers of ozone. This awareness should then spur the public to take proactive steps to reducing ozone levels. The OneSTL [Air Quality Performance Indicator](#) measures ozone levels. The desired trend for this indicator is downward.

# Discover More

The [Earth Science Week](#) website has a lesson plan for teachers entitled “[Plant an Ozone Monitoring Garden](#)” with step-by-step directions on how to plant through how to monitor the garden. This issue of Science Scope (a publication of the National Science Teachers Association) gives another comprehensive teaching plan for students to [observe and collect data on ozone damage to plants](#).

[Hands on the Land](#) provides a clearinghouse for government employees and teachers to find detailed data on ozone gardens.

# Case Studies

## Great Smoky Mountains Ozone Garden

### Contact

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## **Description**

The project began in 2002 as a research project. The ozone gardens were planted at three different elevations in the Smoky Mountains. They were planted with ozone sensitive plants in order to monitor the ozone levels in the mountains.

The Great Smoky Mountain National Park created an education project for schools to come and visit the park in order to see the gardens and learn about ground level ozone pollution. This led to teacher education on how to set up Ozone Gardens in their classrooms. The park used to provide them with the necessary plants.

Hands on the Land maintains the [Ozone Bio-Monitoring](#) site at which can be found a database of the monitoring data collected at the gardens. Teachers can also check the website for data or provide their own data on their gardens. The center still collects data from the gardens.

## **Cost**

The cost to the park to operate the gardens is simply the cost of gardening tools. There is no more funding for the education program, so the current cost to teachers who want plants out of the gardens is \$5 per plant.

## **Lessons Learned**

The park found that this was an amazing educational tool. It teaches students about the scientific method, air pollution and its effects, and provides teacher training.

The researchers who set up the gardens still stay involved in the project and keep updated on plant changes and ozone damage.

The website allows people to ask their own questions about the data. All of the past data is immediately available to the public. There is over 10 years of data on the site, so it encourages lots of questions.

## **St. Louis Ozone Garden**

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### **Description**

St. Louis University, the St. Louis Science Center, and the Missouri Botanical Garden collaborated building an ozone garden. “(The) garden is an education and public outreach project that demonstrates the impact of air pollution on plants and the environment.” More detail can be found in the [St. Louis Ozone Gardent 2012 Project Report](#).

**Cost \$0**

## **Lessons Learned**

The final report lists the project as [an overall success](#). “We believe the St. Louis Ozone Garden’s first year was a success. The public was made aware of O3 pollution, its effects and methods for its reduction; and about the increasing background levels of O3 and its connection with environmental health, conservation and sustainable agriculture. We collected high quality O3 and meteorological data, and worked out a reliable wireless data collection system. The YES students gained experience working in a garden, and steps were made to think about expanding educational activities based on the Ozone Garden concept.”

The project encountered many [common gardening setbacks](#): record high temperatures and drought, an irrigation system that overwatered, various bugs and animals eating crops, and plants that were not growing, to name a few. A complete seasonal breakdown can be found on pages 7-9.