



*This air-powered windmill in San Francisco's Golden Gate Park has been pumping water to the gardens here for almost a century, without the use of any fossil fuels. Air has many uses!*

## Introduction

Fresh air is essential in all gardens. Indoors, it could be the difference between success and failure. Outdoor air is abundant and packed with carbon dioxide ( $\text{CO}_2$ ) necessary for plant life. For example, the level of  $\text{CO}_2$  in the air over a field of rapidly growing annuals could be only a third of normal on a very still day. Wind blows in fresh  $\text{CO}_2$ -rich air. Rain washes air and plants of dust and pollutants. The outdoor environment is often harsh and unpredictable, but there is always fresh air. Indoor gardens must be meticulously controlled to replicate the outdoor atmosphere.



Smoke is immediately sucked out of the room when using this in-line fan. The fan demonstration took place at a trade show in Germany.

Carbon dioxide and oxygen provide basic building blocks for plant life. Oxygen is used for respiration—burning carbohydrates and other foods to provide energy. Carbon dioxide must be present during photosynthesis. Without  $\text{CO}_2$  a plant will die. Carbon dioxide combines light energy with water to produce sugars. These sugars fuel the growth and metabolism of the plant. With reduced levels of  $\text{CO}_2$  growth

slows to a crawl. Except during darkness, a plant releases more oxygen than is used and uses much more carbon dioxide than it releases.



Monitor temperature and humidity regularly. This multi-station setup allows you to monitor several areas at once.



An assortment of temperature and humidity controllers that are commercially available.



*At least one good circulation fan and an extraction fan are necessary in grow rooms.*

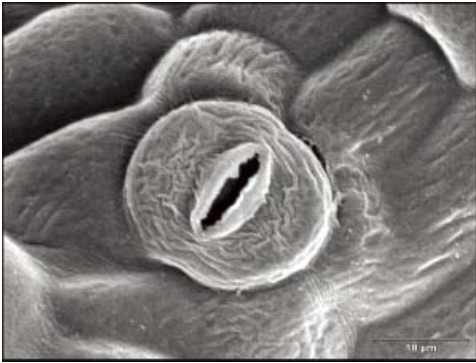
Roots use air, too. Oxygen must be present along with water and nutrients for the roots to be able to absorb nutrients. Compacted, water-saturated soil allows roots little or no air, causing nutrient uptake to stall.

## Air Movement

Air ventilation and circulation are essential to a healthy indoor harvest. Indoors, fresh air is one of the most overlooked factors contributing to a healthy garden and a bountiful harvest. Fresh air is the least expensive essential component required to produce a bumper crop. Experienced indoor gardeners understand the importance of fresh air and take the time to set up an adequate ventilation system. Three factors affect air movement: stomata, ventilation, and circulation.

## Stomata

Stomata are microscopic pores on leaf undersides that are similar to an animal's nostrils. Animals regulate the amount of oxygen inhaled and carbon dioxide and other elements exhaled through the nostrils via the lungs. In plants, oxygen and carbon dioxide flows are regulated by the stomata. The larger the plant, the more stomata it has to take in carbon dioxide and release oxygen. The greater the volume of plants, the more fresh CO<sub>2</sub>-rich air they will need to grow quickly. Dirty, clogged stomata do not work properly and restrict airflow. Stomata are easily clogged by dirt from polluted air and sprays that leave filmy residues. Keep foliage clean. To avoid clogging stomata, spray foliage with tepid water a day or two after spraying with pesticides, fungicides, or nutrient solution.



*This photo of a half-opened stomata, the mouth-like opening on leaf underside, was magnified 2500 times.*

## Circulation

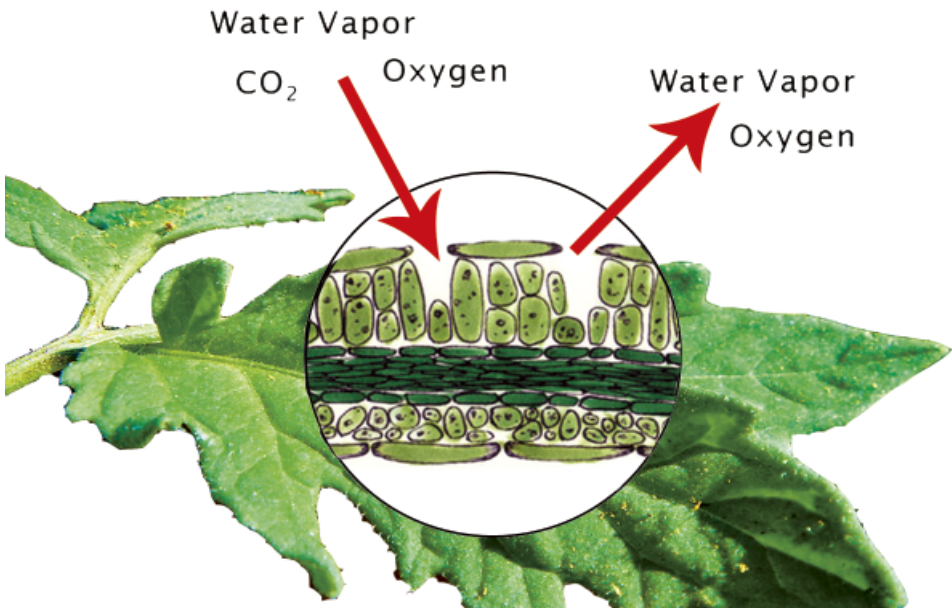
Plants use all  $\text{CO}_2$  around the leaf within a few minutes. When no new  $\text{CO}_2$ -rich air replaces the used  $\text{CO}_2$ -depleted air, a dead air zone forms around the leaf. This stifles stomata and virtually stops growth. If it is not actively moved, the air around leaves stratifies. Warm air stays near the ceiling,

and cool air settles near the floor. Air circulation breaks up these air masses, mixing them together. Avoid these would-be problems by opening a door or window and/or installing an oscillating circulation fan. Air circulation also helps prevent harmful pest and fungus attacks. Omnipresent mold spores do not land and grow as readily when air is stirred by a fan. Insects and spider mites find it difficult to live in an environment that is constantly bombarded by air currents.

## Ventilation

Fresh air is easy to obtain and inexpensive to maintain—as simple as hooking up and placing the proper-sized exhaust fan in the most efficient location. An intake vent may be necessary to create a flow of fresh air in the room.

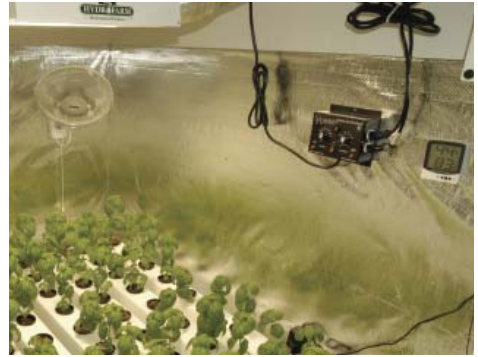
A 10-foot square ( $0.92 \text{ m}^2$ ) garden will use from 10 to 50 gallons (38 to 190 L) or more of water every week. Plants transpire (similar to evaporation) most of this water







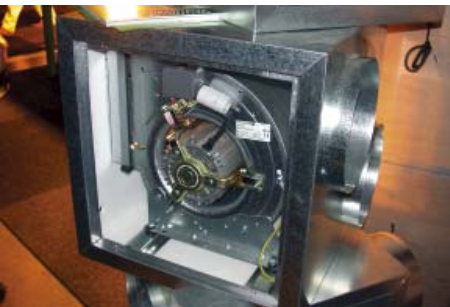
Hot air flows upward naturally. Always design grow rooms and greenhouses to take advantage of this principle.



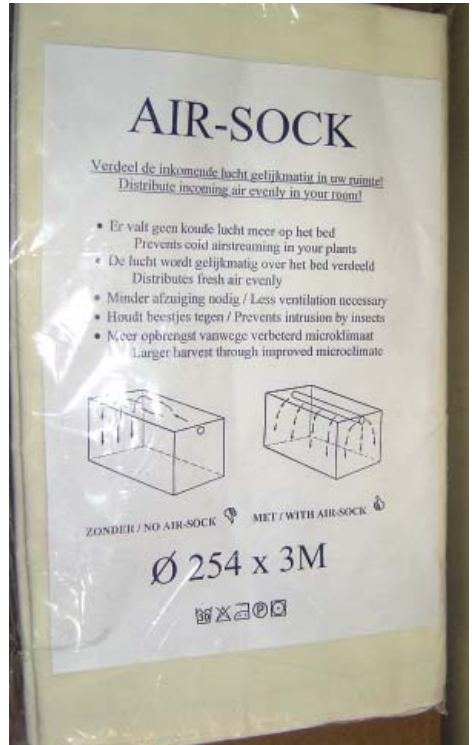
Place circulation fans far enough away from plants to prevent too much airflow on any one portion of the garden.



CO<sub>2</sub> around leaves is used quickly and must be replaced every few minutes.



Here is an example of a heavy-duty extractor fan from a Dutch grow room.



A Dutch innovation is the Air-Sock, a simple, inexpensive method of distributing fresh air throughout your indoor garden. Hang the Air-Sock from an intake vent powered by a blower and the air is spread evenly through the holes along the length of the sock.