

## How Do Plants Get Rid of Wastes?

### Water

Where does it come from?

Water enters the plant by absorption via the root system

Water is a by-product of respiration

Where does it go?

Water is used in photosynthesis

Water is used in hydrolytic reactions

Excess water is released to the atmosphere via stomata in the process of transpiration

Some excess water is forced out of special pores on leaf margins by root pressure in the process of guttation, which is also a method of getting rid of excess salts

### Oxygen

Where does it come from?

Oxygen enters the plant via stomata and roots

Oxygen is a by-product of photosynthesis

Where does it go?

Oxygen is used in aerobic respiration

Excess oxygen is released to the atmosphere via stomata

### Carbon Dioxide

Where does it come from?

Carbon dioxide enters the plant via stomata

Carbon dioxide is a by-product of respiration

Where does it go?

Carbon dioxide is used in photosynthesis

Excess carbon dioxide is released into the atmosphere mainly via the root system

## Nitrogen

Where does it come from?

Nitrogen enters the plant via the root system as ammonium ( $\text{NH}_4^+$ ) and nitrate ( $\text{NO}_3^-$ ), which are dissolved in water

Nitrogen is a by-product of the metabolism of proteins, nucleic acids, and other nitrogen-containing compounds

Where does it go?

Nitrogen is incorporated into various micro- and macromolecules including amino acids, proteins, nucleotides, nucleic acids, and coenzymes

Excess nitrogen can be incorporated into complex nitrogen-containing compounds called alkaloids, which in turn can be stored in dead plant parts (e.g., bark, wood), or stored temporarily in plant parts that will be shed (e.g., leaves, fruits, seeds)

## A closer look at gas exchange

Carbon dioxide enters the plant at the same time that oxygen (along with water) exits the plant via stomata

In most plants, stomata are open during the day (while photosynthesis is going on) and closed at night

Each stoma is flanked by a pair of guard cells, which are suspended by their epidermal neighbors over an air chamber

There are at least three cues that contribute to stomatal opening at dawn: light, carbon dioxide depletion within air spaces in the leaf, and an “internal clock” (keeps track of time and regulates internal processes) in the guard cells

Guard cells actively accumulate potassium, which causes a negative water potential within the guard cells, which causes water to enter by osmosis, which causes the cells to become turgid and pull away from one another, which results in opening

Closing occurs when potassium is lost and water exits the cells

This lecture outline was prepared partly from *Biology*, by Campbell and Reece, 2002 (6<sup>th</sup> edition), and from *Botany – An Introduction to Plant Biology*, by Mauseth, 1998 (2<sup>nd</sup> edition), and may contain phrases or entire sentences taken verbatim from those sources.