What Do Plants Do at Night?

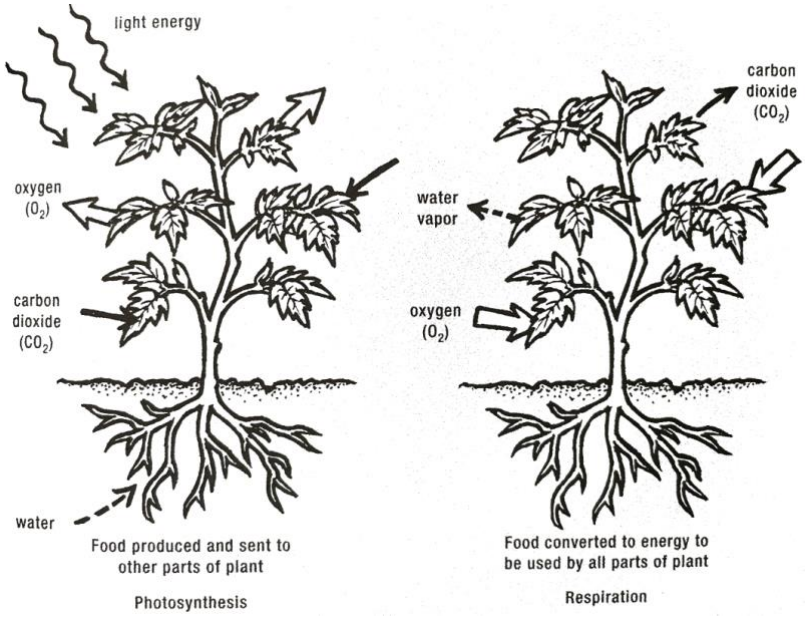
We all know that plants perform photosynthesis — that remarkable and fundamental process that sustains all life on Earth. But the photosynthetic process only takes place in the presence of light; in the dark, photosynthesis ceases. What do plants do at night? Do they simply rest, waiting for the sunrise? The answer is a resounding "no!" In fact, the range and importance of plants' nocturnal activities might come as a surprise.

1. **Plants "Breathe":** If we define breathing as a type of gas exchange — taking in oxygen and releasing carbon dioxide — then plants do, indeed, breathe. Another definition of breathing is the process of moving air into and out of an organism's lungs; defined this way, plants obviously don't breathe. All plants do, however, respire.

   In everyday life, the words *breathing* and *respiration* are often used interchangeably. Scientists offer a more specific definition of respiration; it's the process by which living cells of organisms (including both plants and animals) obtain energy. It involves the intake of oxygen, the metabolism of nutrients, and the release of carbon dioxide. Every living organism uses the process of respiration to stay alive.

   During the day (or, more specifically, when in the presence of light) plants perform photosynthesis — the process by which they use the energy of light to convert water and carbon dioxide into stored energy in the form of carbohydrates. In the process, plants take in carbon dioxide and release oxygen. No light, no photosynthesis.

   However, like us, plants respire nonstop, day and night, continually taking in oxygen and releasing carbon dioxide as they "burn" stored carbohydrates to fuel growth and the many metabolic functions needed to sustain life. Still, plants' net release of oxygen is far greater than their consumption of it. Animals, on the other hand, only *consume* oxygen, making photosynthesis (and the resulting release of oxygen) essential for all life on Earth.



2. **They Grow:** Plants respire around the clock, and they grow around the clock too. During respiration, they burn stored energy to fuel metabolic activity, and this activity includes growth. However, the way they grow may vary. In

the presence of light, plants direct their growth toward the light. The growth that occurs at night tends to be vertical, unaffected by this daytime tendency to reach toward the light. Some plants may even grow faster at night because during daylight they focus their energy resources on photosynthesis.

3. **They Drink, a Little:** Plants take up water at night, but at a much slower rate than during the day. The obvious explanation? Because the photosynthetic process requires water — and plants don't photosynthesize in the dark. But very little of the water a plant takes up (usually less than 2%) is used for photosynthesis. Most of that water is released into the atmosphere during transpiration.

   Transpiration is the process by which water evaporates through stomata (leaf pores). When open, the stomata allow the intake of carbon dioxide and the release of oxygen – the gas exchange that occurs during photosynthesis. The trade-off for having open stomata is that water inside the leaf tissues readily escapes through evaporation. Plant tissue is made up of about 95% water; without a continuous supply of water, the plant dehydrates.

   How do cells in the leaves get the continuous supply of water they need? When water evaporates from the leaf surfaces, it cools the leaf surface and prevents overheating. It also creates the "transpirational pull" that transports water from the roots to the foliage, and this soil-drawn water contains dissolved minerals required by each of the cells. Transpiration also preserves the turgidity of the cells: when the cells are filled with fluid ("turgid"), they're firm and provide structural support to keep stems upright and leaves spread. Lacking water, the cells lose their firmness and the plant wilts. Thus, transpiration is a vital and continuous process for plants.

   Plants transpire — and thus lose water — both day and night. However, they transpire at a much lower rate at night. During daylight, with photosynthesis in full swing, the stomata are fully open to allow the abundant gas exchange it requires, resulting in higher rates of water loss. At night, due to the lower volume of gas exchange required for respiration, the stomata are only partially open. The plants lose less water by evaporation and thus "drink" less at night.

4. **Some Plants Flower at Night:** Some plants bloom during the day, others bloom at night. Both types use their flowers to lure pollinators with visual cues and scents. Day-blooming flowers lure pollinators that are active during the day, such as bees, butterflies, and hummingbirds. Night bloomers have evolved to bloom when *their* pollinators are active — e.g., moths and bats as well as some flies and beetles.

   Night-blooming flowers tend to be white or pale in color and many have strong scents — adaptations to advertise their locations in low-light conditions. Night-blooming cereus, a plant native to Central and South America, is pollinated by bats and moths. The pale, waxy flowers of yuccas release their sweet fragrance at night to attract female yucca moths as part of their interdependent plant-pollinator relationship. Evening primrose, Madonna lily, and night-blooming jasmine also rely on moths for pollination, while bats are important pollinators for agave plants as well as saguaro and organ pipe cacti.

Photoperiodism and Plants: The term photoperiodism is used to describe a phenomenon in which physiological changes occur in an organism in response to day length; that is, the relative amounts of light and darkness in a 24-hour period. Daylight is maximized at the summer solstice; nights are the longest at the winter solstice. Many types of plant growth are affected by the ratio of light to darkness, which enables plants to adapt to seasonal changes, including:

- **Flower initiation.** Some plants begin flowering in response to changing day lengths; For example, some plant species bloom in early to midsummer when days are long, and some produce flowers in fall as the days grow shorter. This timing often coincides with the presence of the plant's primary pollinators. Check out Photoperiodism: Can Plants Tell Time? to learn more.

- **Dormancy.** Shortening day length signals plants in temperate climates to begin preparing for winter. Above-ground growth slows and eventually ceases, leaves drop on deciduous plants, and soft tissues accumulate sugars to prepare for freezing temperatures. This preparation is critical to preventing plant tissue damage and death due to freezing.

How Light Pollution Affects Plants

Most of us have grown accustomed to the well-lit streets of urban and suburban neighborhoods. Sadly, those of us living in these environments can no longer view the night sky in all its glory, with some estimates saying that 80-90% of the entire U.S. population can't see the Milky Way. Nevertheless, many people feel safer walking or driving on well-lit streets.

Plants, however, are affected by the artificial light cast by streetlights, floodlights, and signage. For example, trees growing under streetlights may not be triggered into dormancy — they may continue to grow rather than prepare for winter. This can result in freeze damage. Also, the timing of bloom in plants that flower in response to day length may be accelerated or delayed. This can cause problems in pollination if the flowers open when the species' pollinators aren't around.

The International Dark-Sky Association (https://www.darksky.org/) provides a wealth of information and resources on light pollution, as well as recommendations for "dark sky friendly" outdoor lights.