

Solitary Bee Lifestyle

More than 90% of North America's native bee species are truly solitary, and whether they nest in the ground or in wood tunnels, they share a similar life cycle. Most solitary bees live for about a year, but only three to six weeks as active adults outside their nest. The remaining time is spent developing from egg to adult inside their ground or tunnel nest. There is usually just one generation per year, with the emergence of adults from their nests coinciding with the bloom period of the plants in their native habitat.

The fact that such an overwhelming majority of bee species in North America are solitary, suggests that this reproductive model offers some evolutionary advantage, at least when resources are plentiful. That said, the solitary lifestyle places considerable pressure on the individual female bee to safeguard the continuation of her species. Because she will lay only 10 to 30 eggs in her lifetime, the female solitary bee invests significant time and energy to ensure their survival to adulthood. She does this by creating a protected environment, provisioned with ample food stores, in which her offspring can develop. Following the sequence of her many seasonal labors offers a good glimpse at the typical life cycle of a solitary bee.

Lifecycle of a Solitary Bee

Emergence

An adult female solitary bee will emerge from her nest in spring or summer, depending upon the species. As mentioned, her emergence will generally be timed to take full advantage of the flowering period of her regional forage plants. Almost as soon as she leaves the nest she will be met by males of her species, which have emerged some time earlier and have been closely anticipating her appearance. In most solitary bee species, males emerge from their nests sooner than females, a device which greatly improves their chances of mating; in linear wood tunnel nests the male brood cells are actually located closest to the nest entrance, supporting the male bees' earlier timetable. Males then spend the intervening days loitering about the nest entrance, awaiting the arrival of the females.

Mating

Needless to say, these eager males waste no time in mating once the females make their debut. In some ground-nesting species a gang of over-zealous males may descend en masse upon one hapless female who has barely emerged from her nest.



Male solitary bees typically emerge from their nests several days earlier than the females, which improves their chances of finding female mates. Male digger bees hovering around a nest entrance and converging on a newly emerged female. Photo by Rollin Coville.

Once their role in life is fulfilled, most males will die within a week or two after mating. With the males now off her back, so to speak, the female solitary bee can now focus on the demanding tasks of locating, constructing and provisioning the nests for her offspring.

Locating a Nest Site

Many species of ground-nesting solitary bees will tend to initiate their nests close to the site where they were born. Additionally, while ground-nesting species have individual preferences for topography and soil type, the availability of such ideal sites may be limited. For both of these reasons, many species of ground nesting bees can be found nesting near each other, sometimes in large aggregations or so-called “bee villages”. Despite the close proximity to other females of her species, each solitary female still excavates and provisions her own ground tunnel nest.

For surface nesters that must find suitable wood tunnels or other cavities, this interval before a nest site is located presents the greatest danger to the solitary female bee. Having no safe place to spend the night, she is vulnerable to predation by birds and spiders.



[Diadasia](#) (sunflower bee) ground nest entrances. Some species of ground-nesting bees will locate their nests closely together. Photo by Hillary Sardiñas.

Excavating/Preparing the Nest Tunnel

Once a nest site is established, the female bee must develop her nest tunnel or cavity; in ground-nesting species this entails excavating a nest tunnel in the soil. For surface nesters using pre-existing tunnels and cavities, this task can range from clearing out debris from an existing wood tunnel or irregular cavity, to chewing out the soft pith of a stem or twig.

Constructing and Preparing the Brood Cell

Now the female solitary bee can begin the arduous business of constructing and provisioning her brood cells. Though it varies according to species and weather conditions, in general it takes a female solitary bee about 1 to 2 days to perform the tasks necessary to complete a single brood cell.

The nest architecture of ground nesting bees is highly variable and is characteristic for each species. Regardless of the overall nest design, the female must excavate a chamber for the brood cell, which in some manner is connected to her main tunnel or burrow (via an extended lateral corridor, a short branch, etc.). She then needs to prepare the cell, usually by first compacting and then smoothing its walls. Finally, using glandular secretions, the female applies a waterproof lining to the smoothed cell walls.

Surface tunnel nesters, typified by mason and leafcutter bees, will establish the first brood cell at the rear or blind end of the prepared tunnel. Using species-specific materials which she collects from her environment, such as mud or leaves, the female bee will line the rear wall of the brood cell. Using leaf pieces of a different size and shape, a female leafcutter bee will additionally line the walls of her brood cell. Using her jaws like scissors, she will very precisely clip out several different sizes and shapes of leaf fragments to use in constructing the various parts of her nest cells. It takes only a couple of seconds for this impressive engineer to snip off a suitable leaf fragment, and she always knows exactly which size and shape of leaf piece she will need to detach next!



Female [leafcutter bees](#) cut leaf pieces of different shapes and sizes to line, partition and seal their nests. Photo by Celeste Ets-Hokin.

A Thousand Flowers: Provisioning the Brood Cell, Egg-laying and Closing the Cell

Once the brood cell is prepared, the female bee begins the labor-intensive task of collecting enough pollen and nectar to create a food store for the developing offspring. Depending upon the species, this process typically requires 10 to 20 foraging trips for each brood cell, during which the female visits close to 100 flowers on each trip. A female solitary bee then contacts anywhere from 1000 to 2000 flowers in order to collect enough pollen and nectar to ensure the survival of a single offspring!

On her first foraging trip the female will collect a load of pollen which she deposits into the prepared brood cell. She'll regurgitate nectar onto the pollen, creating a substance known as "bee bread", which most species shape into some sort of loaf or sphere. Following each subsequent foraging trip, the female bee will add more pollen to the developing loaf, until she determines it to be of sufficient size.

Satisfied with the size of the completed food store, the female will lay her first egg, usually on top of the loaf of bee bread. The female controls the gender of her offspring by either fertilizing or not fertilizing the egg. Fertilized eggs become females, while unfertilized eggs develop into males. Because a mated female will store the male sperm in an organ called the spermatheca, it allows her to subsequently govern the timing of her egg-laying and the sex of each offspring.



Tunnel nests of [mason bees](#) (genus *Osmia*) sealed with mud at the entrance. Photo courtesy of the Xerces Society.

Now the cell must be sealed in order to create a protected environment for the developing offspring. Ground-nesting bees generally close the cell with a plug of soil or soil pellets. Surface tunnel-nesting bees use the same material that they used in constructing the rear wall of the brood cell – typically mud, leaves or resin. For example, a leafcutter bee will clip out a dozen or so perfectly sized, circular leaf pieces which she applies one by one to the opening, forming a plug at the entrance to the brood cell. In wood tunnel nests such as this, which will consist of a linear series of brood cells, the completed plug of the first brood cell becomes the rear wall of the next brood cell.



Leafcutter female sealing the entrance to her wood tunnel nest with some last leaf pieces. Photo by Celeste Ets-Hokin.

Another Day, Another Brood Cell: Completing the Nest and on to the Next

The female solitary bee will continue this process of constructing brood cells, provisioning them, egg-laying and sealing the cells until the nest is complete. The number of brood cells in a nest varies with the species of bee, but is usually in the range of 4 to 10. Some ground-nesting bees, especially those that nest in sand, may create only one brood cell per nest. A completed wood-tunnel nest will consist of a linear series of cells, each containing a ball of bee bread and a single egg, separated from its adjoining cells by partitions.



Sealed ground nest entrance of ground-nesting leafcutter bee, Megachile perihirta. Photo by Celeste Ets-Hokin.

Finally, the entrance to the nest is closed or sealed. Again using the same materials used to seal the individual brood cells and/or construct the partitions, the tunnel-nesting female will fashion a seal for the nest entrance. Just as their overall nest architecture varies widely, there is variability in the manner in which ground nesting species seal their nests. Some will create just a mud cap over the entrance, while others may infill a large portion of the main burrow with dirt.

If she is able, the solitary female bee will go on to found 1 or 2 more nests, rarely more. Because most solitary females live for only three to six weeks as active adults, the number of nests they can complete during this short interval is necessarily limited by weather, available forage, etc. Moreover, a typical solitary female bee starts out with only 30 or so eggs, so even if she survives long enough to found multiple nests, at some point she will run out of eggs.

Overwintering and Emergence: The Life Cycle is Complete

Thanks to the tireless industry of their mother, the newly laid eggs will now continue developing into full adulthood within their warm, protected, and fully stocked brood cells. They will pass through the egg, larvae and pupae stages, but remain in their cells as pupae or adults until it is time to emerge during the next spring or summer season. With the emergence of her offspring the following year, the typical solitary bee life cycle has come full circle.



In her short lifetime of only a few weeks, a solitary female bee will visit tens of thousands of flowers in order to provision the nests for her offspring. The plant communities that anchor our North American ecosystems in turn depend upon the prodigious pollinating services of native bees. Photo by Mark Skinner.

For all her heroic efforts to secure the future of her offspring, the solitary female bee will not live long enough to see them. But in her short adult life, she has made not only a significant contribution to the continuation of her own species, but to that of her botanic partners as well. In provisioning the nests for her offspring, the solitary female will have visited tens of thousands of flowers, transferring pollen to nearly as many along the way. And that's the work of just one bee! From this it becomes very clear just how vital a role native bees play in the survival of our ecosystems.