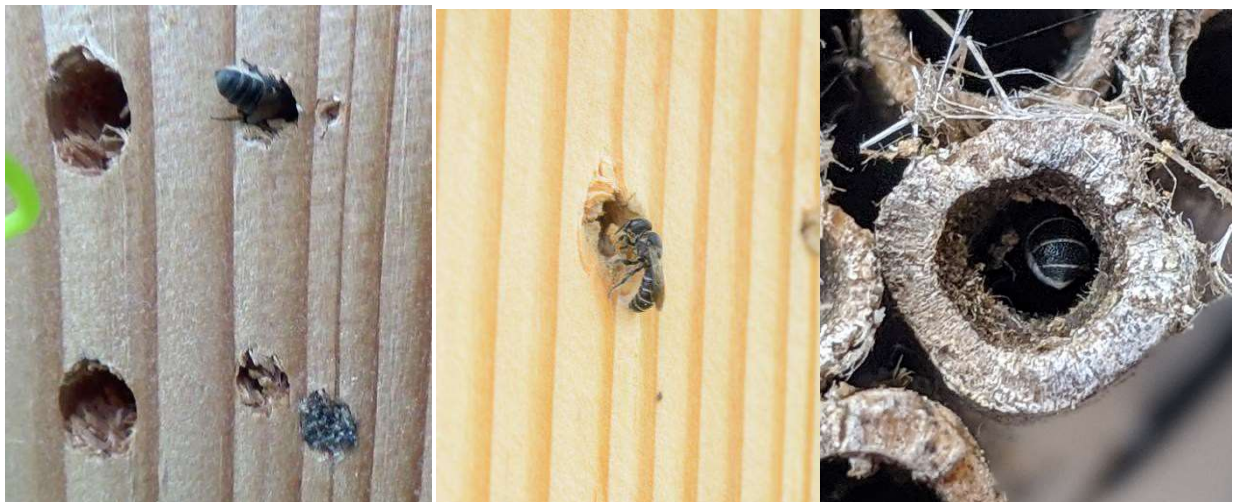


MINNESOTA BEE ATLAS
2022 Volunteer Manual

Block number _____

GPS Coordinates _____



Welcome! You've probably heard news stories about how bees are in trouble and our food supply is at risk. Although this makes for some catchy headlines, these reports typically refer to honeybees, an introduced species that is managed for our convenience. The truth is, we know much less about the native bees that live in our state. With your help, the Minnesota Bee Atlas will fill in critical gaps in our knowledge of tunnel-nesting bee distribution and biology. This guide will provide you with the basic information you will need to hang your bee block, register your block, and monitor your block. Monitoring a nesting block is a great opportunity for you to see wild bees in action and contribute valuable knowledge about their whereabouts and habitat needs in Minnesota.

MINNESOTA BEE ATLAS

The Minnesota Bee Atlas addresses the need for greater information on bees native to Minnesota. In order to know if native bees are experiencing declines, and how to provide for their habitat needs, we need data on which bees live where in our state. One of the knowledge gaps is in the distribution of tunnel-nesting bees. In the first phase of the Bee Atlas, we found four species of tunnel-nesting bees that had never been recorded in the state before, as well as associating many species with particular regions of the state. In the second phase, we will focus on learning about the plant leaves and resins that tunnel-nesting bees use to build their nests, while continuing to refine our knowledge about species, distributions, biome associations, and phenology. Your observations and participation will help us understand these critical pollinators better. Information from the Bee Atlas is combined with information from the University of Minnesota Insect Collection and other sources, and recorded in the Bell Museum Biodiversity Atlas, which anyone in Minnesota can access.

TUNNEL-NESTING BEES

In addition to the introduced European honey bee and our roughly 18 species of bumble bees, there are over 400 other species of bees in Minnesota! Most of the remaining species are solitary, meaning each female nests by herself instead of in a large colony. Of these solitary bees, 15-20% build their nests in tunnels in wood or stems. They may utilize existing holes or chew their own. After locating a suitable hole, the female bee begins to build a little room, called a “cell,” for each of her offspring. As each cell is built, the female stocks it with a mix of pollen and nectar and lays an egg. She then closes the cell and starts on the next one. Once the female has made as many cells as she wants or can fit in the tunnel, she will cap the nest and most likely go on to build more nests. Nesting females die sometime during the summer or fall, and the next generation of bees develops in the tunnel. Sometimes the next generation will emerge as adults the same year they were laid as eggs, but in our climate, the young will generally overwinter either as mature larvae or as dormant adults and will not come out of the tunnel until the following spring.



Three cells of a yellow-faced bee, *Hylaeus spp.*, each containing a nearly mature bee in the pupal stage. Note the dark eyes, leftover reddish food provisions at the bottom of the cells, and a pithy plug capping the nest. (Photo by Colleen Satyshur)

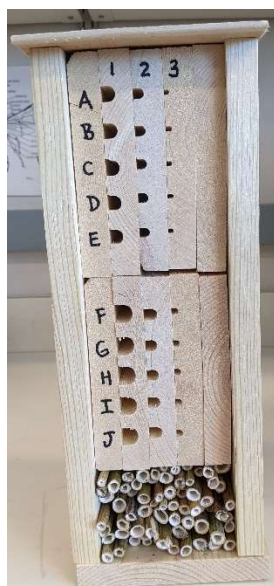
INTRODUCTION TO YOUR BEE BLOCK

In the photos below, you will see an assembled nest block. Your block comes with an individual registration number printed on the side. This unique number will be used to identify the location each bee was found.



Each hole is identified by a unique letter/number combination (eg H2). Bees will use the six different-sized holes to build nests and lay eggs. The unique letter/number identifier will allow us to track activity in each hole.

There is a small length of chain on the back that can be used to hang your block.



A third of the blocks we send will include both wood with drilled holes and plant stems, such as the block at left. Some bees prefer to nest in wood, and some prefer to nest in stems. Including both allows us to learn about a wider range of the tunnel-nesting bee community.

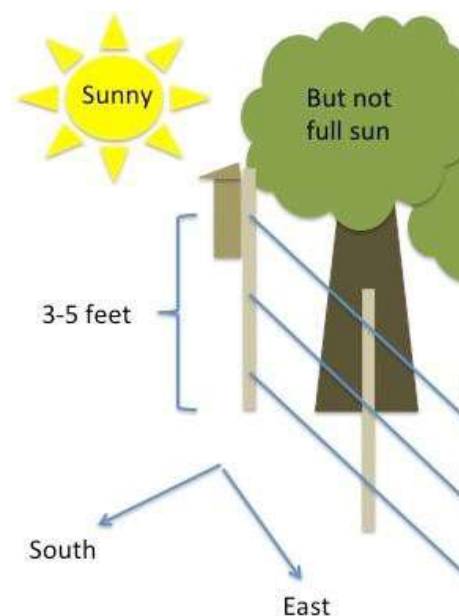
If you get this type of block, you only need to make observations on the numbered holes drilled in the wood block. However, if you see something interesting in the stems, we would love to see pictures!

WHERE TO HANG YOUR BLOCK

The following recommendations were created to help you find a location where you are most likely to attract bees. We understand it may not be possible to meet each qualification so use your best judgment as you choose a location to hang your block. The most important things are that you mount the block securely so it won't move in the wind and you keep the block in the same spot for the entire monitoring season. Bees use visual cues to locate their nest hole and may not be able to find the block again if you move it.

- **Support:** You may choose to hang your block on a tree, fence, sign, building, or other secure structure. If you are not the landowner, make sure you ask for permission before adding any new nails.
- **Height:** 3-5 feet off the ground. This will allow you to easily see in the holes.
- **Direction:** Facing south, east, or somewhere in between. It is thought that these directions allow early morning sun to warm up nests and bees so they can get an early start on their day and be more productive.
- **Accessibility:** Pick a place that you can reliably visit two times each month. You need to get to your block easily on a regular basis during the season.
- **Surrounding vegetation:** Different bees will prefer different vegetation types, but make sure there will be opportunities for bees to forage on flowers near your block. Flowers can include bee-pollinated trees such as red maple and basswood, flowering shrubs such as serviceberries, sumac, viburnums, and willows, or ground-level plants like spring wildflowers, prairie flowers, asters and goldenrods. Be careful that the tunnel entrances will not be blocked by tall vegetation.
- **Sun exposure:** Aim for a spot that is not in full sun or in full shade. Full shade encourages damp conditions which may result in mold, spiders or earwigs living in your holes, while full sun in the heat of the day may be a deterrent to bees. Your block may get more sun when it is cooler in spring before trees leaf out and less sun as the temperature increases in summer.

Make a note of the GPS coordinates when you hang your block and write them on the front of this book. You will need this information when you register your block. You can do this with a GPS unit, smartphone mapping app, or by using Google Maps or another online mapping program. If you are unable to provide the exact GPS coordinates for your block, you may use the coordinates for the nearest road intersection.



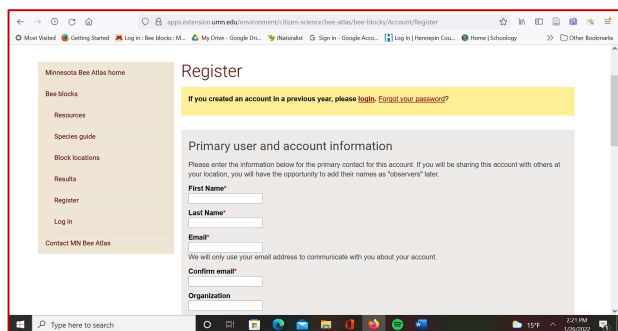
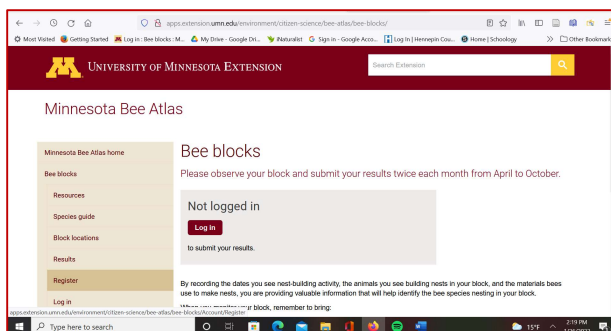
HOW TO HANG YOUR BLOCK

Your block will come with a small length of chain attached to the back to easily hang it on a nail. However, some land managers do not allow new nails to be added or do not want nails in trees. If this is the case, you can use a bungee cord, ratchet strap or wire to secure your block to a tree or post.



REGISTER YOUR BLOCK

Please register your block as soon as you have mounted it at your site. This is important because it links the bees we will find to your location. Registration and data submission will be done at www.z.umn.edu/beeatlas. First click on “Bee Blocks” on the left side of the page and then “Register” where you will be prompted to create your account. Once you have logged in, click on “Manage blocks” and “Add a new block” to enter information about your block. Fill in the required boxes and click “Save.” You will only have to do this once. If other people will be helping monitor the block, you may enter them on the “Manage observers” link on the main menu page. Each block can only be associated with one user account, but a user name and password may be shared by multiple observers.



PREPARE FOR FIELD OBSERVATIONS

Make sure you have your monitoring materials ready when you go to observe your block. You will need:

- Data sheet
- Pencil
- Volunteer manual with instructions
- Flashlight, mirror or otoscope to aid in seeing in holes (optional)
- Camera (optional)

CHECKING YOUR BLOCK AND RECORDING DATA

When to check

Please start checking your block in early April and continue until the end of September. You should observe your block roughly every 2 weeks but the dates do not have to be exact. If you check early in the morning, late in the evening, or when it is overcast or rainy, you may see adult bees resting in their nest holes. If you check during warm, sunny parts of the day you are more likely to see nest building or parasitism in action.

Remember, do not disturb your block while monitoring it, if the block is moved at all, bees may not be able to orient themselves and find their way back to their nest holes.

Observing your block

Get up close and look at those holes!

Bring a data sheet and a pencil to look at each hole. You may want to use a flashlight or small mirror to direct sunlight into holes or use an otoscope (the tool doctors use to see inside your ear) to see into holes better. These can be found for \$7-20 from online retailers like Amazon. We like the ones from Dr. Mom with LED lights and slight magnification, but you may have to experiment to see what works best for you. Take pictures and send them to us if you can! Record what you see for each hole on your data sheet. Bring it back and enter it into our data submission web page.



Observing holes with an otoscope



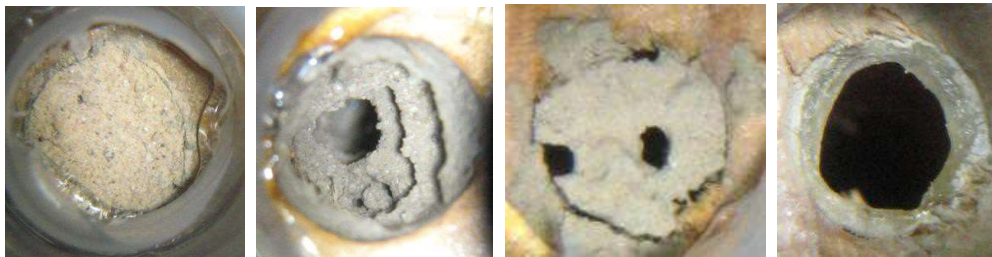
Recording observations

Using your data sheet to guide you, fill out the following information for each hole. These guidelines will help you understand what you are looking at.

Plug

This may be a nest plug, nesting material, or miscellaneous loose material. Plugs seal off the end of a nest, protecting the young and may be the only sign of a nest you see. The material used is characteristic of the bee or wasp species, making plugs a very valuable source of information for us.

- A **full plug** will fill the entire diameter of the tunnel and indicates a complete nest has been built in your block. You may see the full plug either at the end of the tunnel or recessed up to an inch.
- A **partial plug** will look like a plug with a hole in it, or like a narrowing of the tunnel entrance diameter. You may see a partial plug at the end of the tunnel or up to an inch inside. If you see a hole in a plug that was previously fully capped, this could mean that the adult bee or wasp in the nest has completed its development and emerged, or it could mean that nest was parasitized by a wasp.
- **Other material** may include a nest in progress or other materials. You may see frass (the entomological word for poop) left by some non-bee or wasp that is occupying the hole, or it may be nest building in progress. If you are able to see the back of the tunnel, you may see a mass of yellowish grainy playdough (bee nest pollen provisions) or small insects (wasp nest prey provisions).



L-R. Full plug, partial plug (bee or wasp has emerged), partial plug (nest was parasitized), partial plug (threshold built by a wasp).

For full or partial plugs, please note the material the bee used to build the plug. A list of the plugs you may see begins on the next page. Sometimes you may not be able to see into the hole or bees may add debris to another plug type, making it difficult to determine the main material - just do the best you can.

Although our study targets wild bees, you may see other invertebrates such as grass-carrying wasps, earwigs, or spiders using the nest holes. If this happens, don't panic! Record any observations as you would normally, and make a note of what you notice.



L-R: earwig, wasp, potter wasp, grass-carrying wasp, spider. Photos by C. Satyshur

Nest plug categories and descriptions

On the next pages are descriptions of the different plug categories you will see on the data entry web site. Note that fresh plugs may look different than old ones, and changes at your block may not be due to insect activity; for example, green vegetation will turn brown with time, and debris may be stuck to any plug type.

Mud or sand

Mud plugs are made by mason bees and potter wasps. Mud and sand plugs are easy to identify as they look just the way they sound, like mud or sand in a hole. The surface can be smooth or rough and may have stones or fibers worked into it. Plugs can be brown or grey or sandy depending on the soil in your area. Mud plugs can be similar to chewed leaf plugs, but they are never green and have a more cement-like or packed earth quality to them. The plugs are solid, so if debris is present, it will not shift when you poke it. These are one of our more common plug types and occur in all hole sizes. They are frequently broken during the summer as nests emerge or are parasitized.



Photos by C.Satyshur and T. Evans

Resin

Some bees use resin from trees to line their nests and plug the entrance. We will be taking resin samples from nests to analyze and match them to resin producing tree species. Resin plugs may be opaque white, reddish or yellowish and may have debris stuck to them. When resin plugs are fresh, they are sticky; when they dry, they are hard and may look crystalline. This is a very common plug type in our blocks and occurs mainly in the smaller holes. Many wasps use resin also, stocking their nests with aphids. Lighter colored resin plugs may look like cellophane, but they are either tacky or rock hard if you touch them with a tiny twig. These plugs may also look like loose debris, but debris in resin plugs will not move if touched.



Photos by C. Satyshur and T. Evans

Chewed leaves

Some leaf-cutter bees chew up their leaves and make a paste to seal their nests. Chewed leaf plugs often look like greenish home-made paper, with a fibrous texture and sometimes debris worked in with the vegetation. When older, they frequently dry away from the side of the tunnel and fade to brown, when they may be confused with mud plugs. These plugs are fairly common in our blocks and can occur in all hole sizes. We will be taking samples of the chewed leaf material from nests and using DNA analysis to identify the plants they are made from.



Photos by C. Satyshur

Whole leaf or petal pieces

These are the nests of the charismatic leaf-cutter bees, and are usually found in larger holes. Bees snip out circles or ovals of whole leaves and bend them to form the walls and ends of their nests. Sometimes flower petals are used instead. Leaves may be cemented in or just packed in, and you may see just one piece or several to cover the diameter. Whole leaf plugs frequently start out green but may fade to brown or yellow as they age. We will be taking samples of leaf pieces from nests and using DNA analysis to identify the plants different bee species are using.



Top row L-R: plugs made from green leaf pieces, plug made from petal pieces, leaf-cutter bee at tunnel entrance. Bottom row L-R: leaf plugs that have turned brown, holes cut by bees in green ash leaves. C. Satyshur and T. Evans



Loose debris-bits of bark, seeds, mud balls, etc.

Some wasps and bees just pack their nest entrances with loose debris they find lying around. Frequently this means mud balls, sand grains or bits of dead plants or seeds. The difference between this category and any of the others where debris is worked into the main cap material is that this debris will shift a little if you poke it with a blade of grass.



Photo by C. Satyshur

Cellophane

Cellophane plugs will be white, yellow, or translucent, and are delicate films of dried bee spit from a special kind of stem nesting bee-the yellow faced bee, *Hylaeus spp.* Some may have what look like silk fibers worked into the film. They are generally a flat film, will never have debris stuck in them, and will tear like tissue paper if you poke them with a stiff blade of grass. They only occur in the smallest two hole sizes and are uncommon in blocks. Cellophane plugs may be confused with spider webs or resin plugs. However, they are not stringy or sticky like spider webs, and resin plugs will either be rock-hard or sticky.



Cellophane plug and the tiny yellow-faced bee on a flower. Photos by C. Satyshur and T. Evans

Wood

A rare plug type, wood plugs are made of small shreds of wood fixed into a plug. Some leaf-cutter bees plug the tunnel entrance with wood after lining the nest with leaves. Wood plugs may be confused with wood debris stuck in spider webs or resin, but in wood plugs you won't see any background material if you try to shift the pieces slightly.



L-R: wood plugs, side view of leaf-cutter nest with wood plug. Photos by C. Satyshur and T. Evans

Cotton

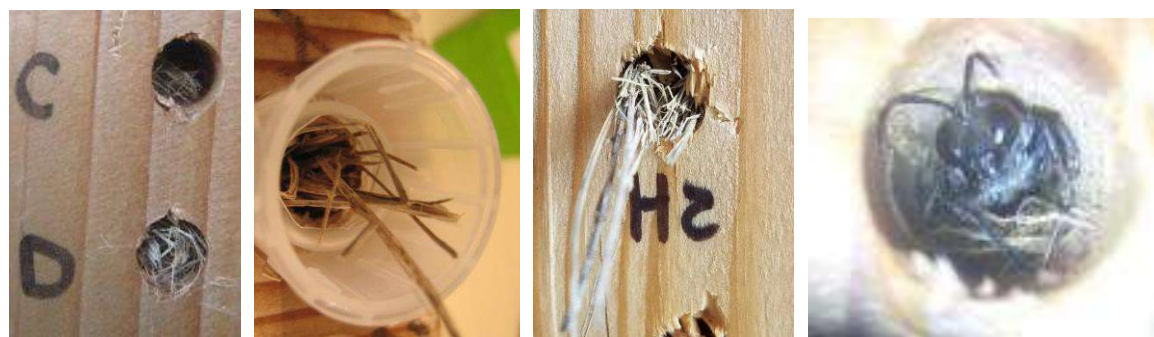
These plugs will look like little cotton balls stuffed in the holes. Some bees scrape off fibers from plant leaves and stuff them in their nest holes. There may be debris stuck to the plug. They may get matted if wet, but they are not stringy like spider webs.



Two cotton plugs and a bee collecting plant hairs from prairie sage leaves. Photos by C. Satyshur and T. Evans

Grass

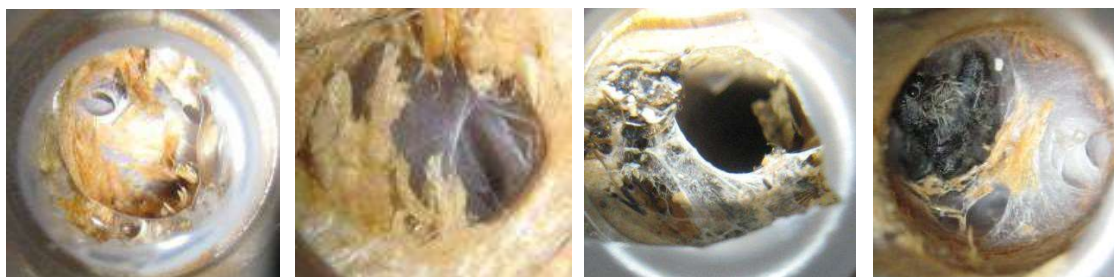
Grass-carrying wasps collect dried grass to build cell walls and plug their holes. Grass plugs are common in large holes and fairly distinct from other plug types. The grass may be packed tightly inside the hole or sticking out. Grass wasps in Minnesota have more than one generations per summer; if you have grass plugs in early summer, you may see them pushed out or matted down after the first generation emerges.



In the first photo, the top hole shows a partial grass plug where a wasp emerged, and the bottom hole is a full plug. On the far right, a grass wasp in her nest. Photos by C. Satyshur

Spider webs

Spider webs are silky white or grey threads, often only a short distance inside the hole. They may seem haphazard or have intricate shapes with debris stuck in them. They do not usually fill the entire hole, but leave a slit in the center where the spider may be seen peering out. To test if it is a spider web, use a thin blade of grass to gently touch the material; if it bounces back or strands stick to the grass, it is spider web.



Photos by C. Satyshur

Unknown

Sometimes, you may see a plug that does not look like anything else in this book. Creative bees may have used an unusual material or other creatures may have used the hole. You can use the “unknown” category when you just can’t tell what is going on in a particular hole. You may want to send pictures of the plugs you see as you get used to monitoring your block. Pictures can be sent to beeatlas@umn.edu or posted to the Minnesota Bee Atlas Facebook page. We’d love to know what you’re seeing at your block!



Some strange sights. Photos by C. Satyshur

Entering Data

Entering your data is very important. The information you provide on when nests are built, which holes are being used, and what materials bees use to build their nests will help us learn about when and how bees build their nests, which can inform land management practices and policy.

To submit your observations to the Bee Atlas, visit www.z.umn.edu/beeatlas and click on “Bee Blocks” on the left side of the page. Then, log in using the account you created to register your block. Each time you submit data, you will start by clicking on “Add New Observation.” The next screen will ask about the date, observer, and weather. Once you have entered that information, click on “Save and Go to Holes.”

You should see a drawing of your block to the right. You can either click on a hole for which you’d like to enter data or you can click on a column at the top to enter data for the entire column at once. Click the hole you would like to edit to fill in the hole status and material. Add images if you have photos of the block or holes.

A BIT ABOUT STINGS

Stings should be a minimal concern. While the female solitary bees and wasps visiting your block are capable of stinging, they are unlikely to sting. The establishment of the next generation depends on the mothers’ efforts, and they will generally avoid conflict. The wasps you may see at your block are most likely grass-carrying or aphid predators. Like the bees nesting in your block, they are primarily concerned with providing for their young and are not aggressive like their more well-known socially nesting cousins; the paper wasps, yellow jackets, and hornets.

That said, your bees and wasps will sting if they feel their lives are threatened. Getting up close and observing your block should not cause them concern, but use common sense and



don't dig in the nest or cause any unnecessary stress. Observers who are allergic to bee stings should take appropriate precautions as they would in any general outdoor setting.

HAVE FUN!

This is most important – enjoy your new adventure. Look for bees peeking out of their holes on a cool spring morning. Notice the different materials that bees are bringing back to the nest. Can you tell what flowers the bees are visiting by the color of the pollen? How many different bees do you see using the block?

Don't panic if you are having a hard time differentiating the various plug types. Plug material can sometimes be hard to distinguish; just do your best and tell us about it! Send pictures to beeatlas@umn.edu or post them to our Facebook page for help with the plug types. You are our eyes on the ground and we value your experience and participation.

There may be days when you do not see any activity at your block. Believe it or not, this is actually very important information so please record it! A lack of bees nesting in your block may mean it is too early in the season for nesting bees, there are not many tunnel-nesting bees in your area, or the block may not be in a place that attracts bees. Use can vary over the summer, so do not get discouraged if you don't see bees using your block.

Share your experience with others! People who walk by your block and see you peering into the holes are most likely curious about what you are doing. Your friends and neighbors might wonder what you are doing when you say you're volunteering. Tell them about solitary bees and how they can help. Share a bee pun; there are tons. We can't reach everyone in Minnesota, but we bet you can.

ACKNOWLEDGEMENTS

The Minnesota Bee Atlas is funded by the Environmental and Natural Resources Trust Fund (ENRTF) as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR)

