EJ'S NEWS

EJ is East Jefferson Beekeepers Association's Mascot.

Volume – 3

September 2022

Gloria Neal- Editor

Index

CLUBMEETING:

East Jefferson Beekeepers' Meeting

Chimacum Grange

9572 Rhody Drive
In Chimacum

Saturday, Sept 10th

Board Meeting 9:30 a.m.
Club Meeting-10:00 a.m.

THE PREZ SEZ

SEPTEMBER 2022

Thanks to everyone who helped out with the Jefferson County fair and a huge thank you to Rich and Susi. Even though they have everything relatively organized from previous fairs, it's a lot of work setting up and taking down our booth. Fortunately, it's a labor of love for both of you. I can see the joy in your faces interacting with the public as you do. We are blessed.

Our focus now shifts to preparing our colonies for winter. As we head into fall it is important to make sure there is enough food but also enough space in the supers. I've lost several colonies over the winter by not paying attention to the latter. They get honey bound and run out of space. I'm sure Rich and many of our experienced beekeepers will lead a lively discussion on this critical issue in our next couple meetings.

Nominations are now open for officers for 2023. We will hold an official business meeting in October to elect your leadership team. Please submit any nominations, including those for yourself, to Susi before our October meeting. Remember we do not hold a meeting in December.

Sincerely

Dave Morris

2022 EXECUTIVE BOARD

President: David Morris

Vice President: Rich Thomas

Secretary: Susi Thomas

Treasurer: Catherine Slaton

Trustees:

Mike Kelley

Tony Weller

Mike Duncan

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Mike Kelley, Rich & Susi Thomas

COMMUNICATIONS
Susi Thomas

ACTIVITIES-EVENTS
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Tony Weller

MENTOR PROGRAM
Mike Duncan

ASSETS MANAGER
Catherine Slaton

MEDIA SPECIALIST
Jim Gurney

NEWSLETTER
Gloria Neal

EDITOR'S NOTES

Hello beekeepers,
This spring and summer has been a very challenging time for beekeepers and honey bees alike.
Through these ups and downs, I feel we have all learned a lot! And we have some incredible new beekeepers who have had some "out of the ordinary" situations that they have handled with flying colors.
And a big THANKYOU to those club mentors who have given of their time, transportation and knowledge to assist those new members who have had some struggles with their hives.
Now we are facing the most challenging time for our apiaries...

GETTING OUR COLONIES THROUGH TO SPRING...
HEALTHY AND THRIVING.

Most important! Medicating our colonies early enough that our queens are still laying eggs, so our colonies go into winter with healthy disease-free winter worker bees.
This means a medication that kills the mites breeding and feeding on the young developing brood inside the brood cells!
As with any medications, do your research. Each manufacturer has safety requirements for its products' use:

- Heat requirements
- Timing requirements
- Hive configuration for medication
- Application
- Storage

<u>Always read ALL of the manufacturer's statements!</u>

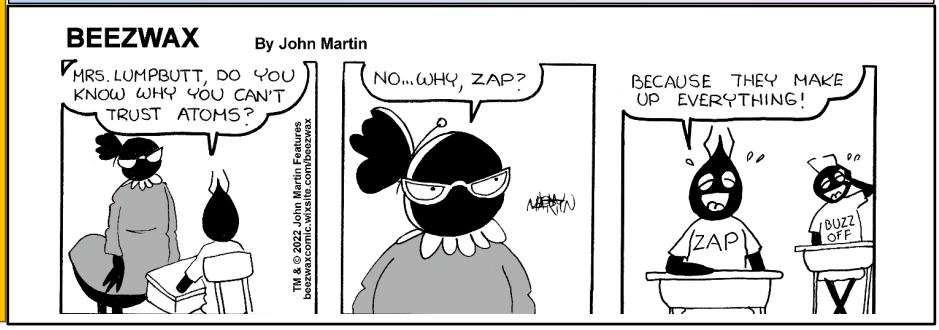
How much honey do you need to provide food stores for your colony for the coming winter? You can find lots of answers to this question.

According to Rusty Berlew on her "Honey Bee Suite" website, Rusty gives a very *general* recommendation of how much honey to leave for your bees as you gather up frames for extraction.

https://www.honeybeesuite.com/how-much-honey-should-i-leave-in-my-hive/ .

My thought is, I like to err on the side of caution, and my ideal is to have all frames in the second story full! Feeding my bees 2 parts sugar to 1 part water early in the fall can help, and if needed, fondant or sugar cakes below a quilt board. We will start discussing winter strategies at our September meeting. Don't miss it!

That's the Buzz for September,
Gloria
eastjeffbees@gmail.com



Next EJBees' Meeting: Sept. 10, 2022 – Mark Your Calendar

9:30 a.m. Board meeting
10:00 a.m. General meeting
Held at Chimacum Grange: 9572 Rhody Dr., Chimacum, WA

Greetings to EJBees members, prospective members, and guests!

The next meeting of 2022 takes place September 10th at the Chimacum Grange, 9572 Rhody Drive (Hwy 19), Chimacum, right across the highway from the Tri-Area Community Center and Chimacum Schools.

Discussion at the general meeting will focus on the timely topic of managing the apiary for *Varroa destructor* mites, continuing honey harvest, and preparation for winter. Our always-lively Q&A is open to your beekeeping questions and comments, and we may have a special presentation about oxalic acid treatment for the mites.

In our apiaries, we should be seeing drones being ejected from hives by this time, and a transition to the bees' own winterizing strategies.

Mid-August, we enjoyed great success with our EJBees educational booth at the Jefferson County Fair, with outstanding participation by 22 members and 5 friends & family of EJBees who interacted with the public to enrich the learning experience about bees and beekeeping.

Thanks to all of you who contributed your time and enthusiasm, and to the other members who dropped by to visit the booth!

We hope to see you all on September 10th for our regular, information-filled, friendly, and fun monthly club meeting at the Grange.
-----Susi


More 2022 Fair Photos:








In the Garden

With Catherine

Any flowering plant that is ignored by slugs and that honey bees converge on is a two thumbs up resident or soon-to-be resident of my garden. Last week I planted a start of a castor bean vine, sprinkled Sluggo around it and found it covered in slugs the next morning, nibbled to its nubbins. Note to self: castor beans are out.

What's a gardener to do? While I pondered this eternal question I kneeled and weeded wondering where had my pineapple lilies gone to? There underneath snaking blackberry, lying patiently below leapfrogging buttercup was the sturdy variegated pineapple lily just sending up its flower stalks. Good ol' pineapple lily, I thought to myself. You are the one I can always count on. You will not fall prey to our non-native brown slugs or be smothered by weeds.

Eucomis bicolor is a bulbous species of flowering plant native to Southern Africa. The pale green, purple-margined flowers are arranged in a spike, topped by green leaflike bracts. I purchased a two-bulb pack four years ago and they have bloomed each August without fail. One caveat: the odor given off by the flower while subtle, is still oddly reminiscent of stale beer. Unless you have your nose within a few feet it shouldn't be a problem. The lily is purported to freely self-sow, so perhaps at blooms' end, I'll collect the seeds and have a huge swath in the next few years for my honey bees.

Catherine

https://www.rhs.orguk/plants/6919/eucomis-bicolor/details

https://www.pesticide.org/slugs

Tips & Tricks

September 2022: a monthly offering of useful hints for beekeepers

by Rich and Susi

- One method to store frames over winter is to stack 5 or 6 boxes of frames with a top, and with a paper plate strewn with ~6 tablespoons of "PARA-MOTH" insecticide crystals placed in the topmost box to discourage wax moths.
    - PARA-MOTH is safe for honey bees. DO NOT use naphthalene mothballs!
    - Use appropriate PPE when handling crystals.
    - Check every 3 or 4 weeks and replenish crystals as needed (they dissipate).
    - Be sure to give the frames a good airing-out before using them in hives again.
- If you treat hives with Mite Away Quick Strips, be sure to seal off the screened bottom board. Please follow package instructions carefully regarding daytime temperature requirement, number of days to treat, etc.
- Melt wax off the queen excluder to keep it clean & open to traffic, collecting the wax on a paper towel to use as a fire-starter in your fireplace or barbecue.

If you would like to submit your own tip or trick for possible future inclusion, please send it to
richandsusi@ejbees.com

IN THE APIARY

Catherine

On the to-do list for my apiary is the combination of a hive that refuses to requeen itself and refuses to accept an introduced queen, with a nuc that is queenright. It's September, so let's combine those two colonies and get them through the winter.

But how does a beekeeper discourage the relocated hive–in my case, the queenless colony–from returning to its old hive location? Consider this method, courtesy of Gloria Neal.

1. Either late at night or **early morning (See step 3)** close the hive being relocated. Block entrance with fitted slat, cloth, etc.

2. Relocate hive next to recipient hive keeping all entrances closed.

3. Allow ventilation for higher-than-normal temperatures. This is critical especially if you are closing up your hive or transfer in the am. Fine hardware cloth may be tacked over entrance holes. Thin shims may be placed between lid and top of box or inner cover before moving.

4. Keep hive closed for twelve hours. Make sure the colony has time to settle down before opening hive.

5. Prior to opening board entrance, place leaves or small leafy branches directly in front of the opening so foragers have to crawl through them. Make sure the entrance is not too jammed and that there is room for the bees to exit. The garden refuse will signal the foragers that they are in a different location, allowing them to reset their GPS and navigate back to their new home.

5. Hives may them be combined using either newspaper or parchment paper method.

Caution: Make sure you only have one queen per hive!

https://www.honeybeesuite.com/how-to-combine-colonies-with-newspaper/

–Catherine

. . ."Welcome to EJBees!"

SOME BENEFITS OF BEING AN EJBEES MEMBER

1. Participate in EJBees beekeeping classes in person and online, free of charge
2. Link up with an EJBees mentor
3. Or b*ecome* an EJBees mentor!
4. Borrow EJBees assets for your use: e.g., honey extractor, back issues of *American Bee Journal*
5. Enjoy member privileges on our blog, **ejbees.com:** e.g., list beekeeping items wanted or for sale
6. Get a 5% discount at Frank Neal's Tarboo Valley Woodenware & Bees
7. Participate in special events, such as Rhody Parade, Jefferson County Fair, apiary visits
8. Obtain a swarm through the EJBees swarm response "rescue" program
9. Become (automatically) an associate member of Washington State Beekeepers Association
10. Display a "photo of the month" to show your special technique, method, or observation on the blog
11. Vote on matters concerning the operation and direction of the EJBees organization
12. Receive "EJ's News" monthly newsletter and special notifications

Pollen vs Pollen Patties

We have subscribed to the *American Bee Journal* for a while now, and I must say that some of the articles as well as the extensive "question and answer" section are well written and address some basic and interesting topics.

For example, an article in the last edition poses the question of whether bees convert pollen substitute or pollen supplement patties to bee bread, and alternatively, whether they feed pollen patties directly to brood.

The findings, well referenced, are that they *do not*. Using dye tests, researchers found no pollen patty contents in either larvae or bee bread, but rather, only in adult bees.

Remember that the best pollen supplement is pollen itself; the bees can figure it out for themselves after that.

---------Rich

For a more detailed discussion and full references to the original research papers, see J. Ellis, "The Classroom" [Q&A: Are Pollen Patties Converted to Bee Bread?], *American Bee Journal*, August 2022, 162(8): 845.

HONEY TIME

Here's a nice 6 ½ - pounder , not all capped yet.

How are your frames shaping up?

Let's compare notes at the September meeting!

Rich

From *Bee Forum* on Beesource

**my filled shallows are 5 lb*
--Dubuqur, 2011

**a nice medium frame* nets *4 lb*
--Jim Lyon, 2011

**a filled deep is 9 lb, but don't forget to subtract wood & wax*
--Scrapfe, 2011

"Volumetric Efficiency" from Beekeepertips.com

**10-frame shallow: 3 lb/frame*

**9-frame shallow: 3.5 lb/frame*

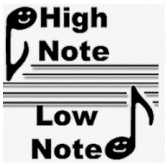
**8-frame shallow: 4 lb/frame*

Bee Biology

How and Why do Bees Buzz?

HOW DO BEES BUZZ?

The most familiar sound of bees has to do with their FLIGHT. When honey bees fly, they beat their wings very fast—about 230 times per second. This speedy movement of the wings through the air, along with the rapid quivering of the bee's body as the flight muscles work very hard and quickly, together create vibrations in the air that sound to our ears like *BUZZ-ZZZ-ZZZ-ZZZZ-ZZZZ* !



Some bigger bumble bees beat their wings more slowly (200 times per sec.), and accordingly, produce a lower buzz note. A mosquito, which is a much smaller insect, beats its wings at a rate of 400, which produces a very high and irritating buzz like this: "zzzzzzzzzzzzzzzzzzzzzz!" In contrast, a graceful, slow-flying butterfly flaps its pretty wings just 6 times every second and accordingly, makes no sound at all.

In 1912, an explanation was proposed in the book, *The Humble Bee,*[1] that a bee's buzzing sound results from the movement of air in and out of the breathing-spiracles *(see "How Bees Breathe" on the EJBees blog, ejbees.com, Bee Biology section)*, as it vibrates a curtain-like membrane just inside the port hole-like opening, where the "windpipe" enlarges to form a "sounding box," as he termed these structures.

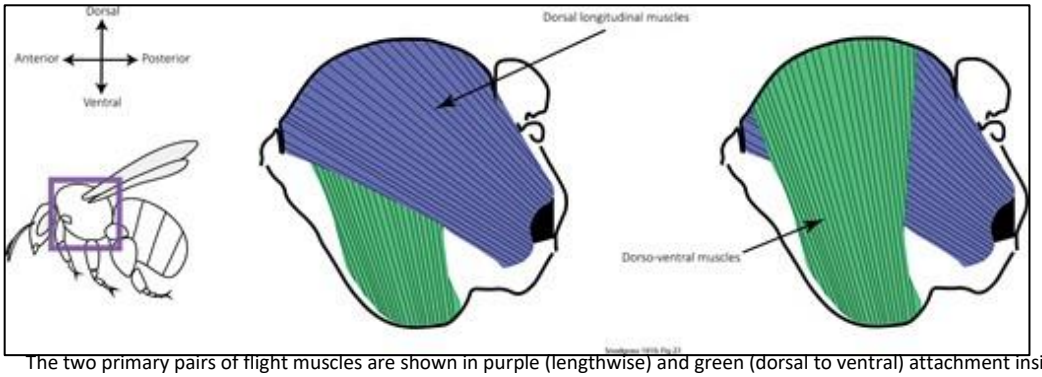
Bees breathe through *spiracles*—round "portholes" on each side of the body

Interesting idea, but incorrect!

More current studies (for example, Vallejo-Marin 2022) examine in detail the way the bee's flight muscles and wings operate and how that relates to buzzing.

The muscles are attached to the INSIDE of the thorax—which is the bee's external skeleton—and the wings are attached to the OUTSIDE of the thorax. When the flight muscles contract, the thorax deforms as it is pulled at different points from inside, and the elegant hinge-like attachments of the wings on these moving body walls are flexed one way and the other, causing the wings to move up and down in a figure-eight pattern for flight or fanning.[2]

Two pairs of major flight muscles are responsible for the main opposing contractions that power flight. One pair runs lengthwise in the dorsal portion of the thorax; the other attaches across the thorax from dorsal to ventral sides near the center (see illustration). Various smaller auxiliary muscles are attached to points inside where they can control the fine adjustments of wing movement.[2]



The two primary pairs of flight muscles are shown in purple (lengthwise) and green (dorsal to ventral) attachment inside the bee's thorax; rapid contractions of these two pairs in opposition power the bee's wingbeat (Diagram: M. Vallejo-Marin)

Continued on Page 8

Bee Buzz continued from Page 7

All these super-quick flexing and bending moves of the thorax produce the sound we perceive as buzzing, which is then augmented and magnified by the vibration of the insect's wings beating the air at high speed.

Even without wing motion, a honey bee can produce a buzz simply from the same flight-muscle action while the wings remain folded quietly at rest, disengaged from the motion of the thorax. This vibration is transmitted either through the air or is conducted through the constructed wax comb in the hive, as the bee grasps the comb and presses the thorax against it. Transmitting this kind of buzz through the comb is called "piping."

In addition to the sound produced by the intensive muscular effort, these vigorous power-contractions also produce significant *heat*.

WHY DO BEES BUZZ?

BUZZING FOR COMMUNICATION: When buzzing is used for communication, the wings may or may not be involved. In either case, the major flying-power muscles are at work, assisted by various smaller auxiliary flight muscles inside the thorax that contract and release, modulating the sound.

(1) DEFENSE: A honey bee's *buzz* can be a warning communication when it is defending itself or its hive, whether the bee is flying or standing on its six little feet to oppose wasps, robber bees, or other intruders.

(2) QUEEN COMMUNICATION: A newly emerged virgin queen announces her presence to the colony and to other new queens still sealed in their cells. Her piping is also called "*tooting*" and is characterized as a long first toot (1 second) followed by several shorter pulses, produced as described above by contracting and releasing the flight muscles while the queen presses her body against the comb, keeping her wings folded on her back. [3,4]

The queen's pure tones are at about 400 Hz frequency – close to G-sharp/A-flat, described as a musical note.[5] Listen to an emerged queen's tooting here https://www.youtube.com/watch?v=KCeV4LWcJu0 or here https://www.youtube.com/watch?v=oaudlgBhOQQ (this video also provides a good view of a dark, slim, quick-moving virgin queen; turn the sound up).

The queens not yet emerged respond with their own piping, called "*quacking*" – that is, a series of very short pipes of slightly lower pitch: https://www.youtube.com/watch?v=9naKEy1v6Lw.

(3) WORKER PIPING: Workers in a colony ready to swarm use a different piping sound to signal nestmates when it is time to warm up their wing muscles for *imminent "lift off"* in flight.[6]

The workers that project this series of short, under-1-second-long pipes at about 200 Hz are mostly (or *all)* nest-scouts that have chosen the swarm's destination and are alerting nestmates that it is time to get going. While piping, the workers pull their wings tightly together.[6]

"Stop!" is another piping message workers use in various situations, distinguished from the previous *lift-off* message by the positioning of the wings apart at rest, instead of together, as the piper emits short beeps (~1/10 of a second each), sometimes accompanied by head-butting the recipient of the message.[5,6]

This message is used in queenright colonies by pollen-foragers to stop a waggle-dancer if conditions have changed at the site to which the dance was recruiting; it is also used by water collectors and receivers as

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Bee Buzz continued from Page 8

they go about their tasks. Egg-laying workers in a queenless hive will also pipe the same wings-open message; the significance in that circumstance has not been elucidated.[7]

(4) COLONY STATUS: Perhaps unintentionally, bee colonies broadcast information about the hive's general status at any given time by their individual and collective running commentary: their "basic hum."

That is, whenever we inspect our bees, we listen for a familiar and somehow comforting sound from our contented and smoothly-running hives. Indeed, experienced beekeepers can often more specifically evaluate the particular status of each hive—calm, angry, hungry, queenless or queenright—simply by the sound, which consists of vibrations that can range from 10 to 1000 Hz.[5]

And by the way, bees have no ears, but "hear" vibration frequencies using the Johnston's Organ in their antennae, at least up to the level of 500 Hz. They may sense higher frequencies in other ways. (*See "The Bee's Antennae" on the EJBees blog, ejbees.com, Bee Biology section.)*

BUZZING FOR CLIMATE CONTROL: Heating, cooling, and circulating air inside the hive are also accomplished by working the flight muscles.

(1) *HEATER BEES* buzz without engaging the wings to keep the hive warm, especially in areas where brood is located. Sometimes a heater bee places itself inside a vacant cell among those that are occupied by larvae to warm the brood through the waxen walls.

(2) Similarly, during winter when the greatly reduced colony forms a single cluster the hive, the outer sphere is composed of *HEATER BEES* constantly generating warmth, while an inner sphere of *FANNERS* use their wings to circulate the warm air throughout the cluster, especially into the center where the queen resides.

(3) When the hive is too hot and stuffy inside during summer months, workers line up in place at the entry and fan their wings with a gentle hum to keep the hive *cool and fresh.* Others may fan inside the hive over a droplet of water to humidify and cool the air.

BUZZING FOR POLLEN:

(1) *Not* honey bees, but rather, bumble bees, mason bees, and some other native species use the same trick of vibrating their flight muscles and body without moving their wings, specifically for the purpose of shaking a lot of pollen from certain flowers.

(2) The flowers that require this type of pollination include several important crop plants such as tomatoes, kiwis, and blueberries, along with a great number of native plants in North, Central, and South America.[7]

(3) They belong to a variety of different families but have in common a particular structure of their pollen-producing organs (*anthers*): they are tube-like and hold pollen tightly inside, with only a few small pores or slits through which pollen grains can be released—a bit like a stubborn salt shaker or an old-fashioned piggy bank that requires a lot of joggling and rattling to extract the contents.

(4) Buzz pollinators grasp the cluster of anthers tightly with their feet, wrap their body around underneath for better pollen-capture, and vibrate their flight muscles in short bursts, sometimes adjusting the frequency to suit each flower species.[2]

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Bee Buzz continued from Page 9

Typically, the frequency for buzz pollination is higher than that of a bee's normal flight; a large bumble bee, for example, is said to use a frequency of about C-sharp for pollination – about 275 Hz – in contrast to 200 Hz for flight.[2]

This behavior makes them more efficient pollinators of this type of flower and yields a greater load of pollen for the insects to carry back to their nests than honey bees can obtain from the same sources.

Nonetheless, honey bees CAN and DO pollinate these flowers, although less efficiently than do the bumbles *et al.* One blue flower in particular, a Mediterranean native that is a common "weed" in our Pacific Northwest gardens, is a year-round, absolute favorite of honey bees for its generous nectar along with its hard-to-get pollen: borage!

CONCLUSION

The honey bee's buzz is such an obvious a characteristic of this species and all its relatives, it seems surprising that its generation and functions (the *How* and *Why*) were not illuminated until relatively recently, with modern instrumentation for measurement and analysis to provide a finer framework for understanding.

Indeed, most older bee biology textbooks include the assumption that bees are completely **deaf,** at least by human standards. It requires that one steps outside of the limits of one's own perception to imagine the world as bees see, hear, smell, and otherwise sense it within the darkness of their hives and the bright sunlight of their floral landscape.

Notes and References

1. FWL Sladon, 1912, *The Humble Bee*, Macmillan and Co. Ltd., London.

2. M Vallejo-Marín, 2022, "How and why do bees buzz? Implications for buzz pollination," *Journal of Experimental Botany,* Feb. 2022, 73(4): 1080-1092.

3. ML Winston, 1987, *The Biology of the Honey Bee,* Harvard University Press, Cambridge, MA.

4. WH Kirchner, 1993, "Acoustical communication in honey bees," *Apidologie* 24: 297-307.

5. "Sound waves are measured by their frequency in Hertz [Hz], or cycles per second. The frequency of sound waves is heard as pitch; a higher wave frequency creates a higher pitch. Musical notes correspond to particular frequencies of those waves: for example, an orchestra tunes to the A tone, which has the frequency of 440 Hz." MEA McNeil, 2015, "Sounds of the hive: Part 1," *Bee Culture,* September, cover story.

6. TD. Seeley and J Tautz, 2001, "Worker piping in honey bee swarms and its role in preparing for liftoff," *Journal of Comparative Physiology* (A) 187: 667-676.

7. H Cooley and M Vallejo- Marín, 2021, "Buzz-pollinated crops," *Journal of Economic Entomology,* 114 (2): 505–519.

EJ-Bee keeping Kids' Pages .... by Susi

Photo-Gallery: Kids who volunteered at the Jefferson County Fair for the Bee Club, August 13

Grace Winn explaining to County Fair visitors what's going on in the EJBees observation hive in our booth

Jake Winn as "EJ", Grace Winn with her sign, Logan Winn with his smoker, and Ruth Ann Patterson guiding them along from behind as they stroll the fairgrounds to invite everyone to visit the EJBees' beekeeping booth and kids' workshop

WHAT DO YOU KNOW ABOUT HONEY COMB?

Hey Kids! You know what's inside a bee hive, right? ***Honey comb*** made of wax that the worker bees produce. Each comb is made up of hexagon-shaped ⬡ wax "cells"---thousands of them in each comb! Cells are used for storing nectar, honey, and pollen, also as nurseries for the bees developing from egg to larva, to pupa, to adult. And sometimes workers use an empty cell as a cozy place to take a nap!

The wax is produced in 8 special glands in the bee's abdomen. It is a clear liquid when it is first made, but emerges as tiny sheets, or "scales" of pure white wax.

Scales of white beeswax are extruded from the glands in a honey bee worker's abdomen.

Interesting comb facts:

- Young workers 12 to 18 days old make the most wax.
- It takes about 800,000 scales of beeswax to build 1 pound of comb, which equals 35,000 cells.
- One pound of beeswax comb can hold about 22 pounds of honey.
- The bees strengthen the comb wax by adding propolis.

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When they are building comb, bees warm up the wax to about 109°F, shape it in their mouths, and build a cell that is the perfect size to fit one bee inside. The walls are super-thin, just 3/10,000ths of an inch, can you imagine that? But each bee does not build a cell by herself---it takes hundreds of bees working on it, each one in turn, to build a single cell.

Because a lot of the cells will hold nectar or honey, they are constructed to tilt the teensiest bit upward at an angle of about 10 degrees (actually between 9 to 13) so the liquid won't spill out.

It's a wonderful thing that bees do, building their home with amazing comb made from their own wax!

HA HA HA!

Why did the honey bee queen's dessert wobble when she tried to eat it?
Because it was royal jelly.

3

What do you call a bee who can't make up its mind?
A may-bee!

What do you call a bee who is having a "bad hair day"?
A frizz-bee.

Who says "zzub zzub zzub"?
A bee flying backwards.

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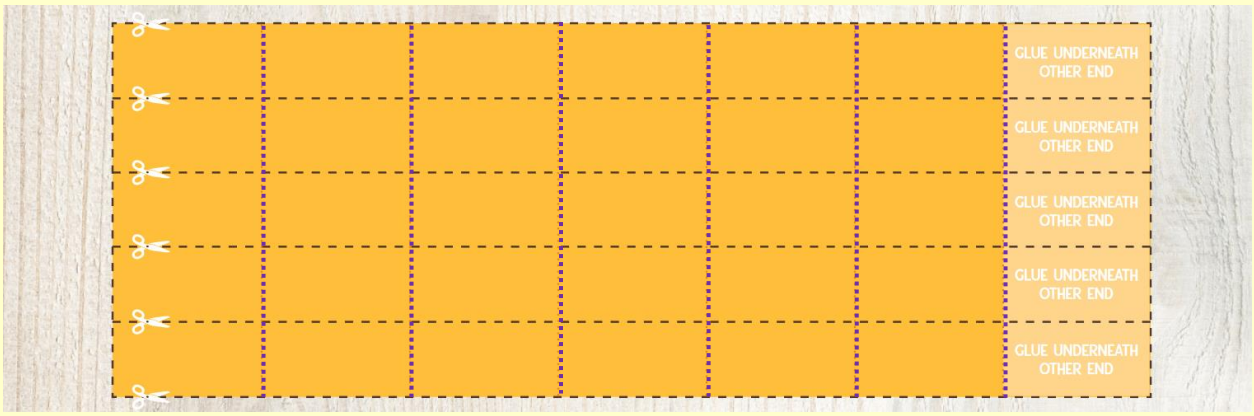
Print this Page

Be A Hive-Maker

Adapted from National Honey Board's "Inside the Hive" activity at honey.com

Cut out the strips below along the brown dashed lines and then fold along the purple dotted lines and glue ends together to make hexagons.



Assemble hexagons on top of the honey comb template below to create your own 3-D bee hive.

Now, you mathematically- or experimentally-minded, or model-building kids can take this further: do a couple of somewhat challenging experiments on comb strength and efficiency—next page!

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Further Experiments: Comb Strength and Efficiency

Adapted in part from Kim Lehman's *Beekeepers's Lab*

Print this Page

You Need:

- a ruler
- a pencil
- index cards, 4 X 6 inches
- tape
- a series of heavy objects, such as cans, plastic jars, or small boxes: *about* 1, 2, 3, 4 lb
- (optional: a kitchen scale, if you have one)

Instructions: Experiment 1. The purpose is (1) to test the strength of "cells" of four different shapes (triangle, square, circle, and hexagon) to support weight, and (2) to evaluate the efficiency of building comb with the strongest of the cell shapes. Use one of your index cards as your "lab notebook" to write a record of your results as you work (see Step 6). Illustrations are on page 15 to help you.

1. Use a ruler and pencil to mark the folding points along the top and bottom lengthwise edges of one index card for each shape:
    a. Circle—make no marks, because you need no folds.
    b. Triangle—make two marks 2 inches apart, to make 2 folds and 3 equal sides.
    c. Square—make 3 marks 1½ inches apart, to make 3 folds and 4 equal sides.
    d. Hexagon—make 5 marks 1 inch apart, to make 5 folds and 6 equal sides.
2. Draw a line from the top mark to the corresponding bottom mark to use as a folding guide for each card.
3. Carefully fold along each line for each card and tape the open edges together to form the different shaped tubes.
4. Stand the tubes on their ends in a row.
5. Assemble your series of test weights—call them number 1,2,3, and 4 (weights are printed on the labels, or you can weigh them on a kitchen scale).
6. Experiment: Test each tube by placing one weight at a time on each tube noting whether it can hold the weight up or does the tube collapse. Write your results on the table ("yes" if it holds, "no" if not).
    a. First weight, 1 lb: Does the circle (triangle, square, hexagon) stand, yes or no?
    b. Second weight: Does the circle (and each of the tubes) stand, yes or no?
    c. Continue testing with increasing weights until only one (or maybe two) remain.
    d. Which shape or shapes are the strongest!

Weight Number	***CIRCLE***	***TRIANGLE***	***SQUARE***	***HEXAGON***
1				
2				
3				
4				
More?				

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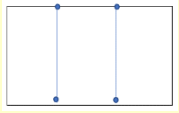
Continued from Page 14



For Steps 1 and 2: Measure, mark, and draw lines.

For Step 3: Carefully fold each card on the lines and tape the open edges together to form the circle, triangle, square, and hexagon tubes.

For Steps 4-6: Assemble a series of weights, numbered 1, 2, 3 and 4, then test all four tubes with #1; then all four with # 2, then #3, and #4, writing down which tubes hold up the weight without collapsing each time.

For Step 6: Oops! My poor little triangle tube **collapsed** with Weight #3----good thing I had my hand right on that plastic jar so I could catch it before it fell down!! I marked Triangle – #3 – **"No"** on my table of results.

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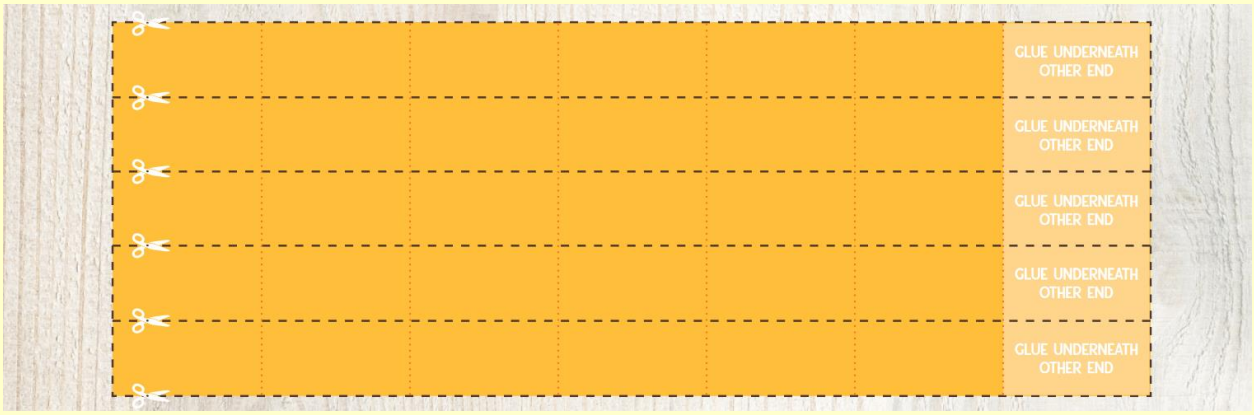
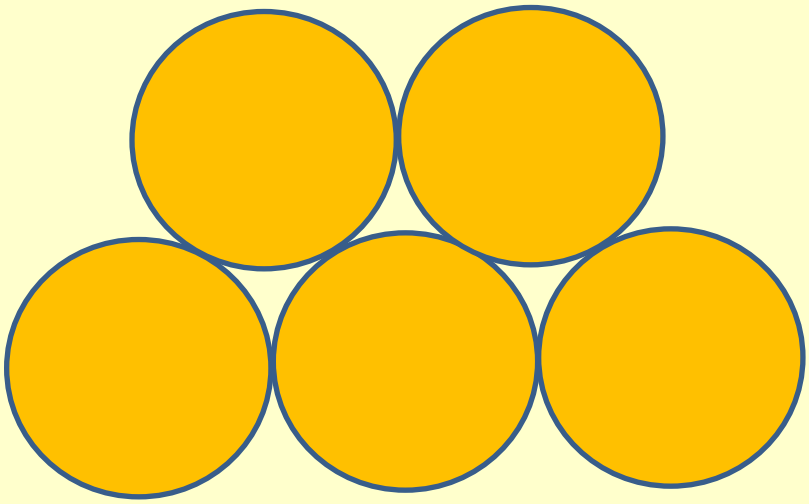
Instructions: Experiment 2. The purpose is to see which of two cell shapes (circle and hexagon) is most efficient in how tubes of that shape can pack together to fill the space of the hive. This has to do with space as well as the amount of building-material (wax) that would be needed.

You already have done half of the experiment with hexagons from the previous hive-maker activity. Let's repeat it with circles:

1. Cut the 5 gold strips on the brown dotted lines.
2. Do NOT mark or fold the strips. Just glue or tape them as shown to make 5 circular cell tubes.
3. Now pack them closely to build a comb and compare this with comb you built with hexagons:
    a. How well do they fit together?
    b. Which one fills up the space more completely?
4. Which shape of tube would you choose to build your own honey comb?





A SWEET FACT: Hexagonal comb is perfect for a bee colony's use because it is the strongest shape to fit the most honey inside without wasting any precious SPACE or MATERIAL.

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