



Be warned—

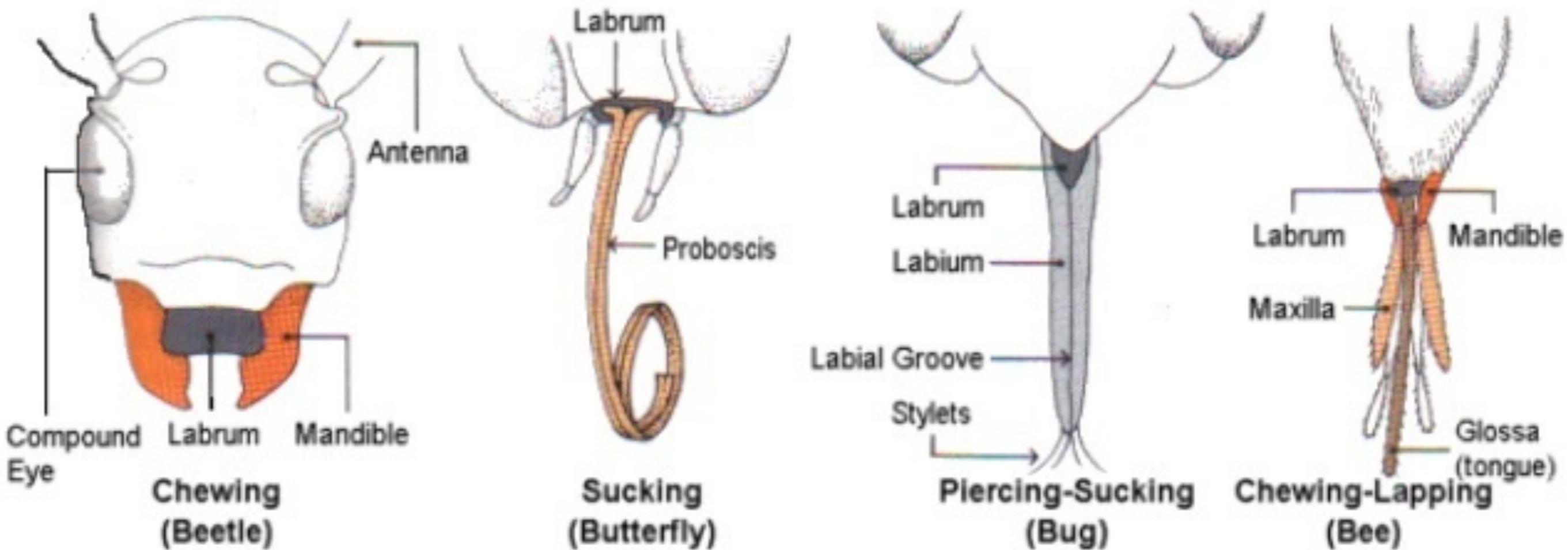
having
a sweet tooth
can
bee a killer.

January 22, 2019

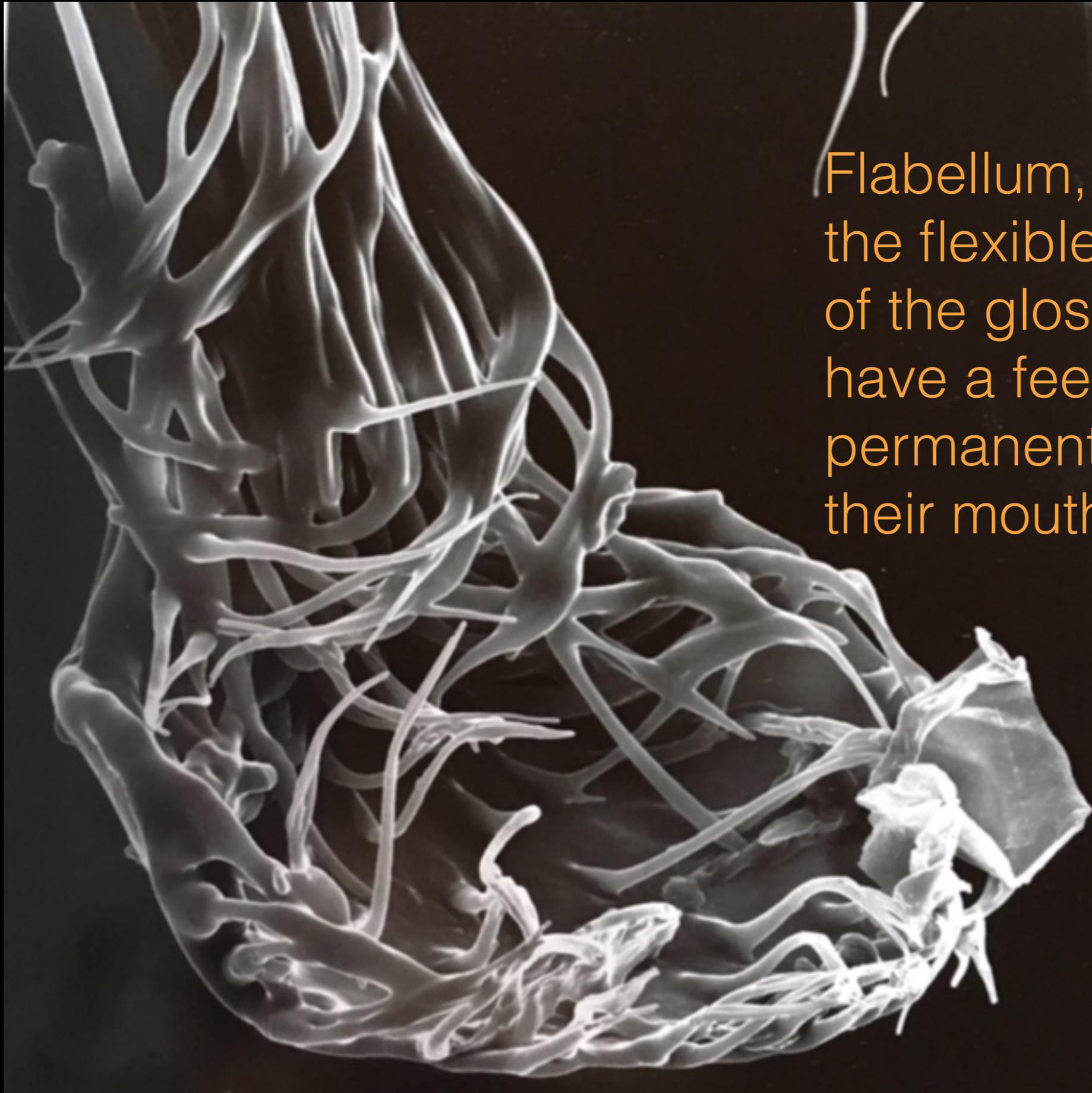


How the honey bees gather nectar.

Three nectar drinking techniques



Active suction (butterflies)
Capillary suction (hummingbirds)
Viscous dipping (ants, bees, bats)



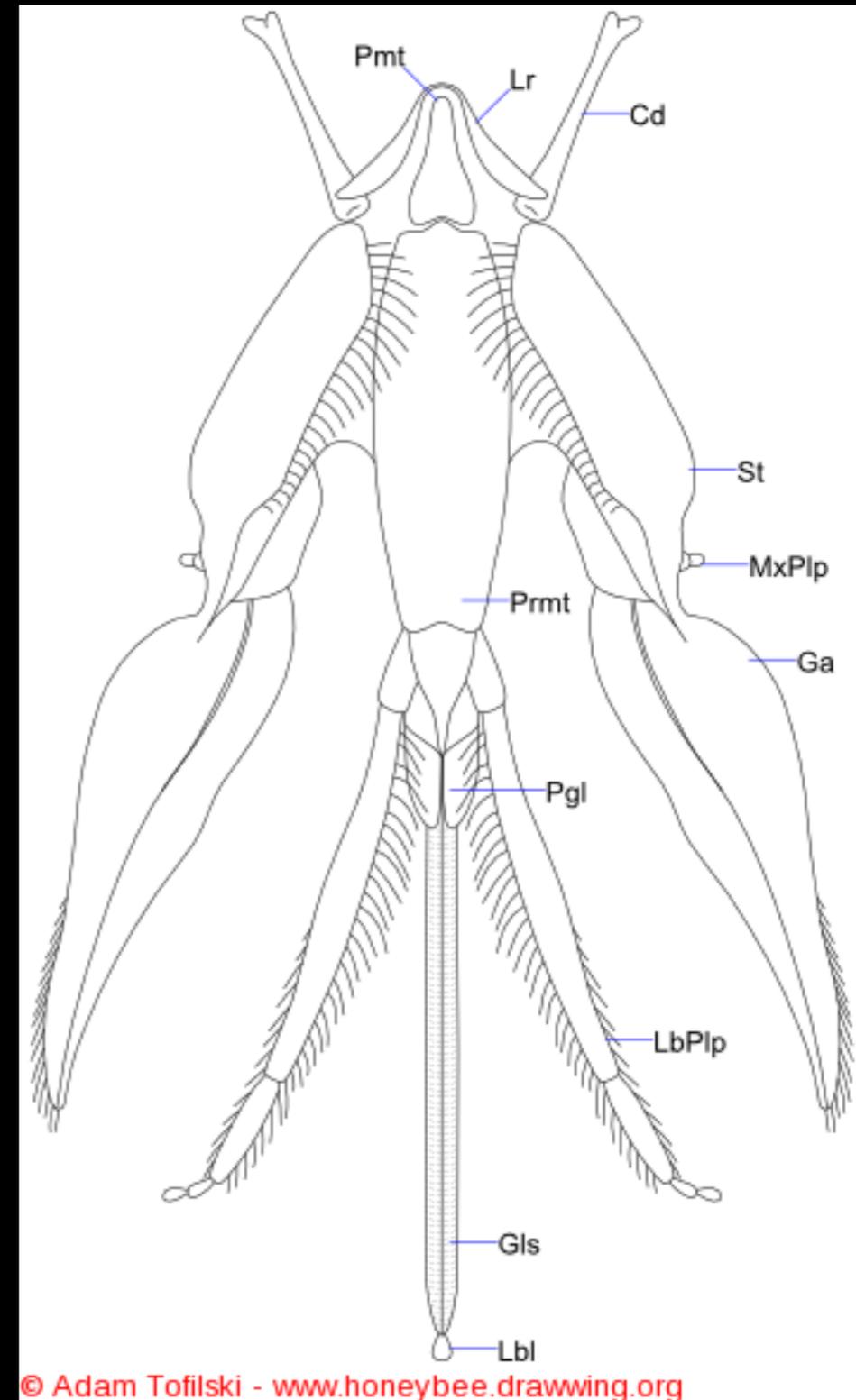
Flabellum, the flexible spoon-like tip of the glossa. Bees do not have a feeding tube permanently sealed around their mouth.

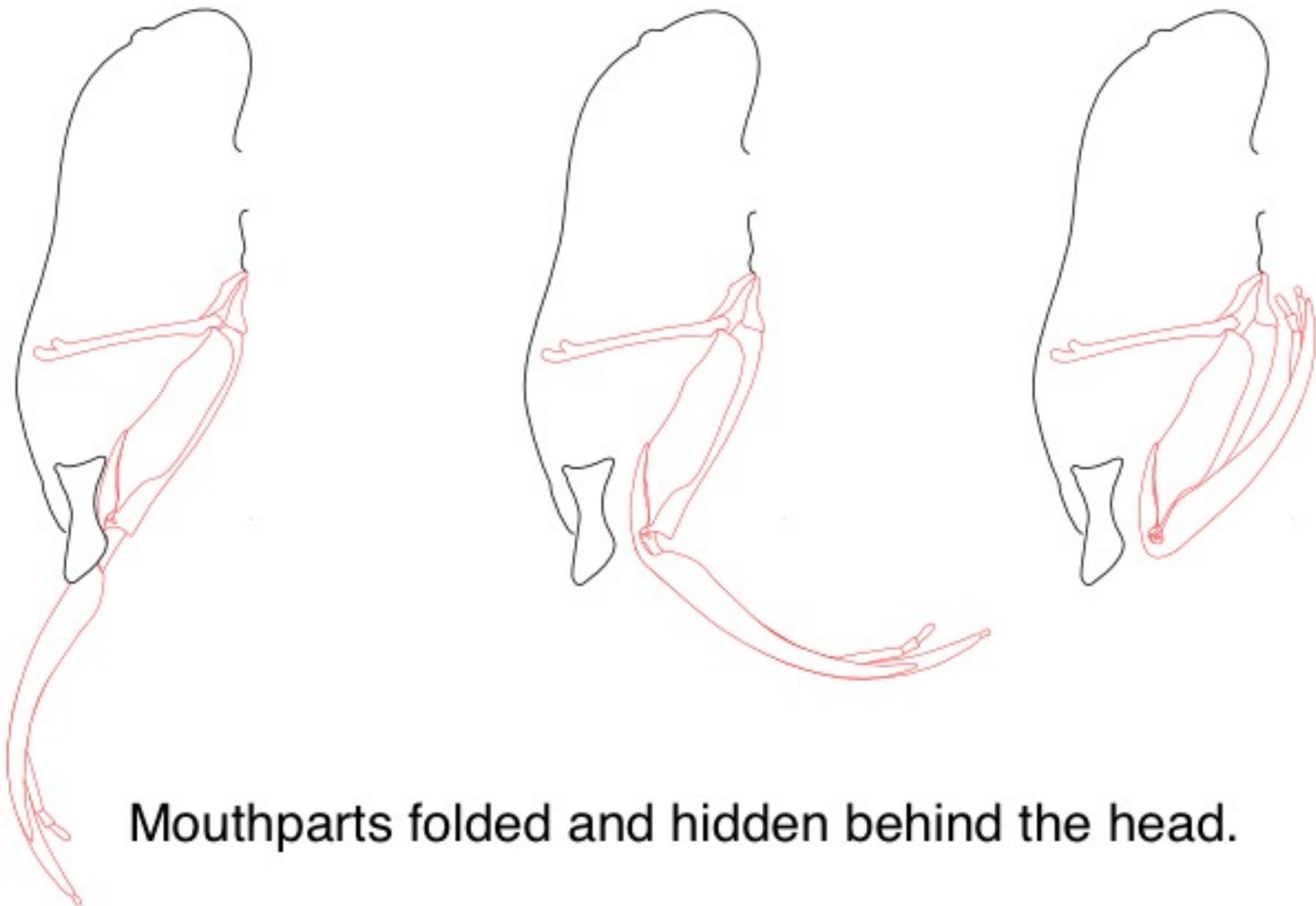
proboscis 600x
Rose-Lynn Fisher

Feeding on liquids

The galeae, labial palps and glossa together form the proboscis.

- The galeae overlaps in front of the glossa.
- The labial palps join in back of the glossa.
- The galeae and the labial palps together around the glossa form the tubular food canal to draw liquids into the mouth.
- Bees do not have a feeding tube permanently sealed around the mouth. They must be able to use their mandibles to manipulate substances.
- An open mouth allows to regurgitate for brood and other adult feeding, & deliver nectar into mouths of receiving bees.





Mouthparts folded and hidden behind the head.

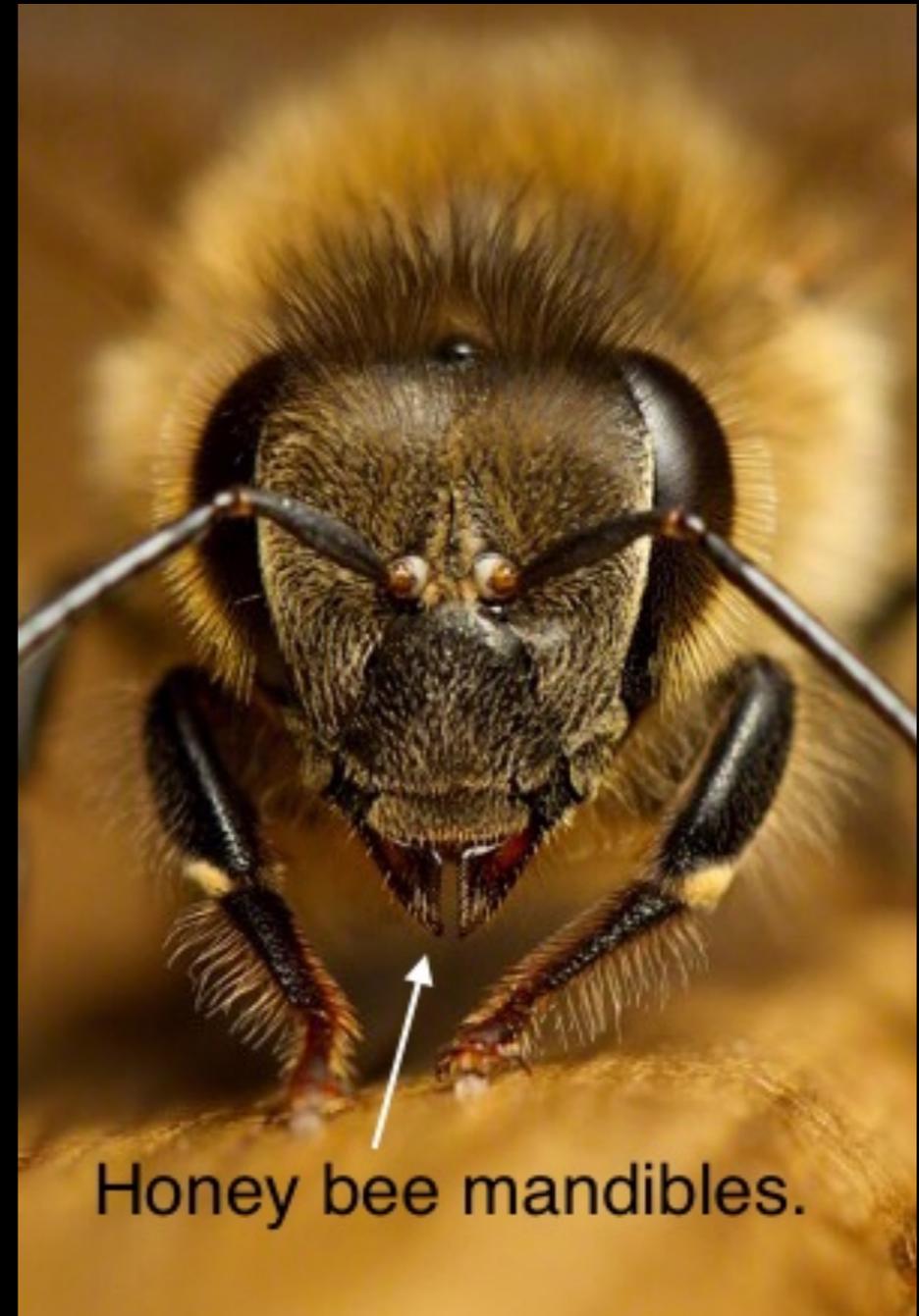


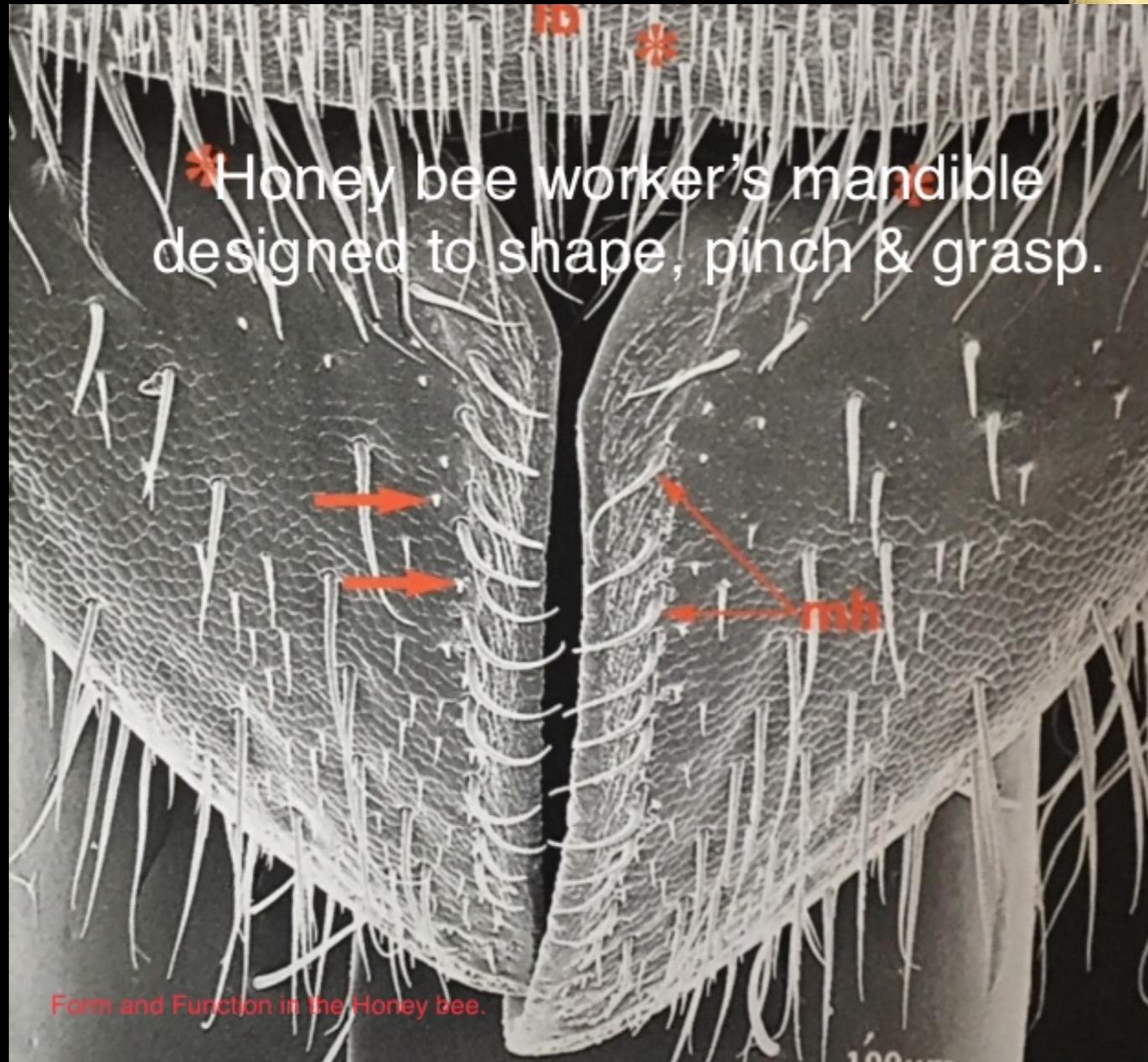
*How honey bees access honey
without a hive tool.*

Bee wise, bee-ware, use the mandibles with care.

Mandibles will show wear
over time doing colony tasks.

Construction of comb &
capping cells,
collection of propolis,
manipulating pollen,
housekeeping duties,
defensive behavior,
feeding, etc.





* Honey bee worker's mandible designed to shape, pinch & grasp.

Form and Function in the Honey bee.



Yellowjacket's mandible overlaps & designed to bite, cut, grasp & grind.

© Charles Krebs 2006



Paper plate removal from hive.



Bees removing bias tape used to tie comb to a frame.

*Honey bees are selective
about their nectar
concentration.*

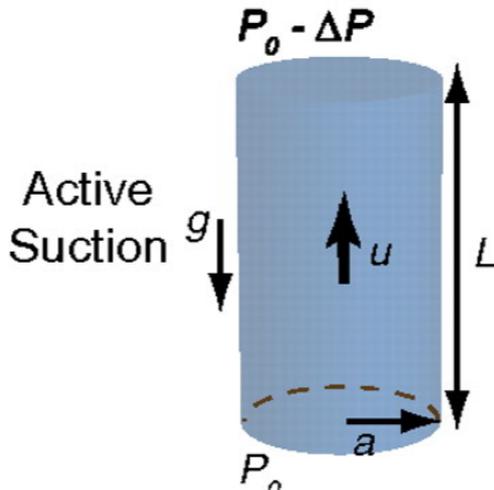
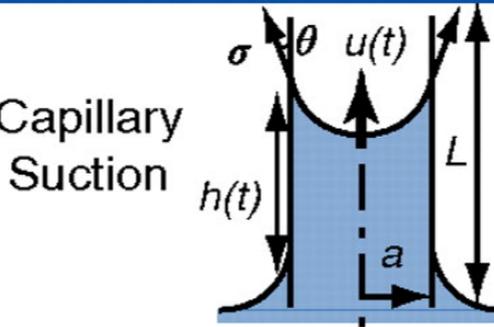
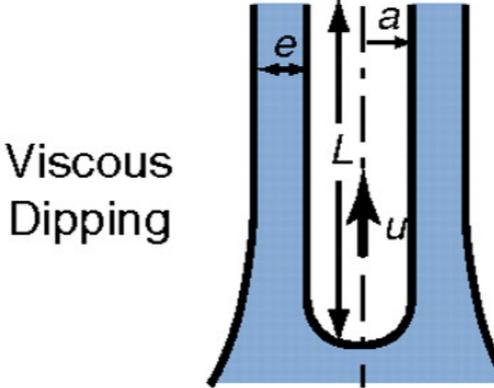


Optimal sugar concentrations for various nectar feeders

- Nectar drinkers must feed quickly and efficiently due to the threat of predation.
- Increase of viscosity with sugar concentration also is the most difficult to transport.
- Sugar concentration that optimizes energy transport depends exclusively on the drinking technique.
- The sweetest nectar offers the greatest energetic rewards.
- Apis* peaks at a 52% sucrose concentration.

Illustration: National Academy of Sciences

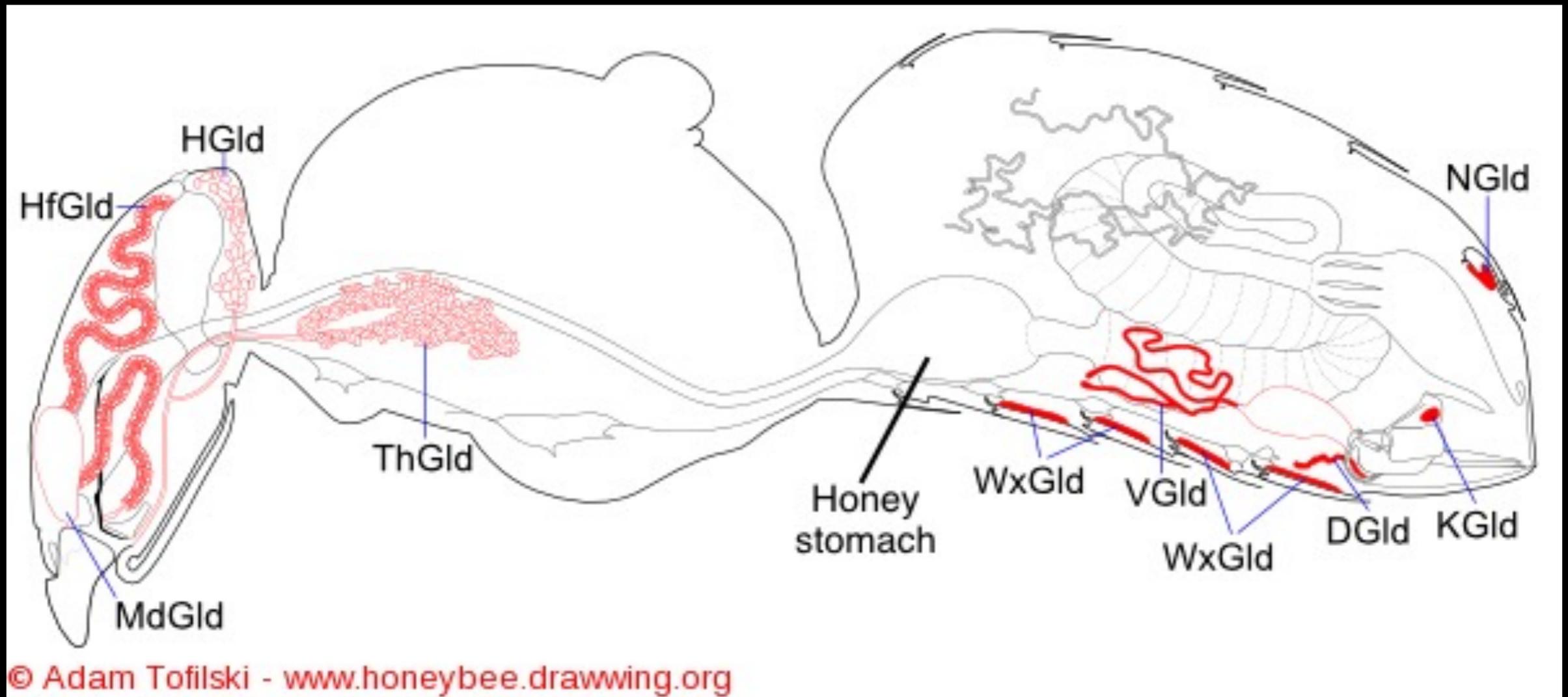
Wonjung Kim, Tristan Gilet, and John W. M. Bush. 4 Oct 2011. Optimal concentrations in nectar feeding. *PNAS*. 20 Dec 2018 <https://www.pnas.org/content/108/40/16618>.

Mechanism	Name	Genus	Optimal (%)
 <p>Active Suction</p>	Ants	<i>Atta</i> (5) <i>Camponotus</i> (5)	30 40
	Bees	<i>Euglossa</i> (18)	35
	Butterflies	<i>Agraulis</i> (12)	40
		<i>Phoebis</i> (12)	35
		<i>Speryeria</i> (24)	35
		<i>Thymelicus</i> (2)	40
	Moths	<i>Vanessa</i> (25)	40
		<i>Pseudaletia</i> (2)	40
		<i>Macroglossum</i> (26) <i>Manduca</i> (27)	35 30
	 <p>Capillary Suction</p>	Hummingbirds	<i>Selasphorus</i> (16) <i>Selasphorus</i> (28)
Honey-eaters		<i>Anthochaera</i> (29)	50
		<i>Phylidonyris</i> (29)	40
		<i>Acanthorhynchus</i> (29)	30
Sunbirds		<i>Cinnyris</i> (30)	30
 <p>Viscous Dipping</p>		Ants	<i>Pachycondyla</i> (5) <i>Rhytidoponera</i> (5)
	Bees	<i>Bombus</i> (8)	55
		<i>Apis</i> (9)	55
		<i>Melipona</i> (9)	60
	Bats	<i>Glossophaga</i> (31)	60

Honey Bees Supplemental Sugar

- Sucrose = Glucose-Fructose
Table Sugar or Baker's Sugar (Caster)
- Invert Sugar = Free Glucose + Free Fructose
- Drivert® = Sucrose (92%) + Fructose (8%)
- HFCS-55 = Glucose (42%) + Fructose (55%)
High Fructose Corn Syrup

Science v. Anecdotal for Inverting Sugar



Justification for inverting sucrose for honey bees is not based upon nutritional data but on an assumption that hydrolysis aids digestion. Invertase (sucrase) showed abundant in bees' hypopharyngeal gland that appeared to be almost completely atrophied.

Roy J. Baker. 1977. Considerations in Selecting Sugars for Feeding to Honey Bees. *USDA, Bee Research Laboratory.*

American Bee Journal, Feb, 1977, Vol. 117(2):76,77. 20 Dec 2018

http://www.three-peaks.net/PDF/feed_Considerations%20in%20Selecting%20Sugars%20for%20Feeding%20to%20Honey%20Bees.pdf. (Abstract only).

J. Simpson, Inge B. M. Riedel & N. Wilding. 24 Mar 2015. Invertase in the Hypopharyngeal Glands of the Honeybee. *Journal of Apicultural Research*. 20 Dec 2018

<https://www.tandfonline.com/doi/abs/10.1080/00218839.1968.11100184>. (Summary only).

Science v. Anecdotal

- Bees showed preference for solutions between 68° - 95° F, ingest nectar more easily & carry a greater crop load.
- Bees avoided higher nectar viscosities with successive feeder visits.
- Bees showed strong preferences for both warmer and less viscous nectar, independent of changes in its sugar concentration.
- Bees may benefit from foraging on nectars that are warmer than air temperature for two reasons: reduced thermoregulatory costs and faster ingestion times due to the lower viscosity.

Susan W. Nicolson, Leo de Veer, and Christian W. W. Pirk. 2013 Sept 22. Honeybees prefer warmer nectar and less viscous nectar, regardless of sugar concentration. *Proceedings of the Royal Society B: Biological Sciences*. 20 Dec 2018. <https://royalsocietypublishing.org/doi/pdf/10.1098/rspb.2013.1597>.

Signs of impending winter starvation

- Any food in the hive must be in contact with bees, otherwise they will not find it (bees too cold to move).
- Colonies with less than 10-15# of food anytime (easily depleted).
- Additional increase in body heat required for higher brood nest temperatures increases honey consumption (brood rearing).
- Bees clustered out to frame one in a horizontal hive (cannot reverse across empty frames).
- Bees clustered at the top of the upper-most body in a vertical hive (cannot reverse down empty frames, bottom box too cold).



SocketMat

SocketMat is Swedish meaning sugar food.

Simply made with refined cane sugar.

No additives.

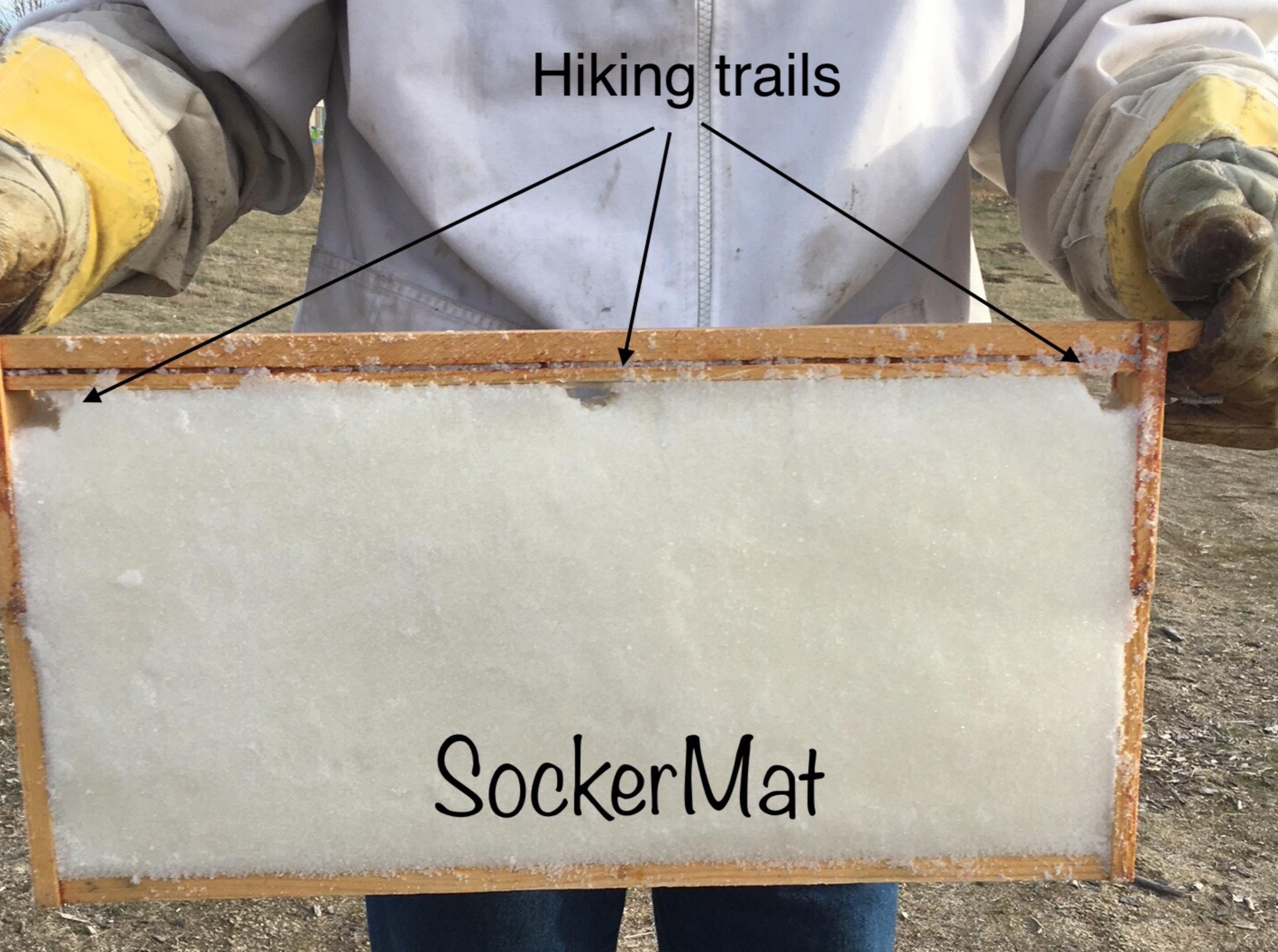
No applied heat. No HMF.

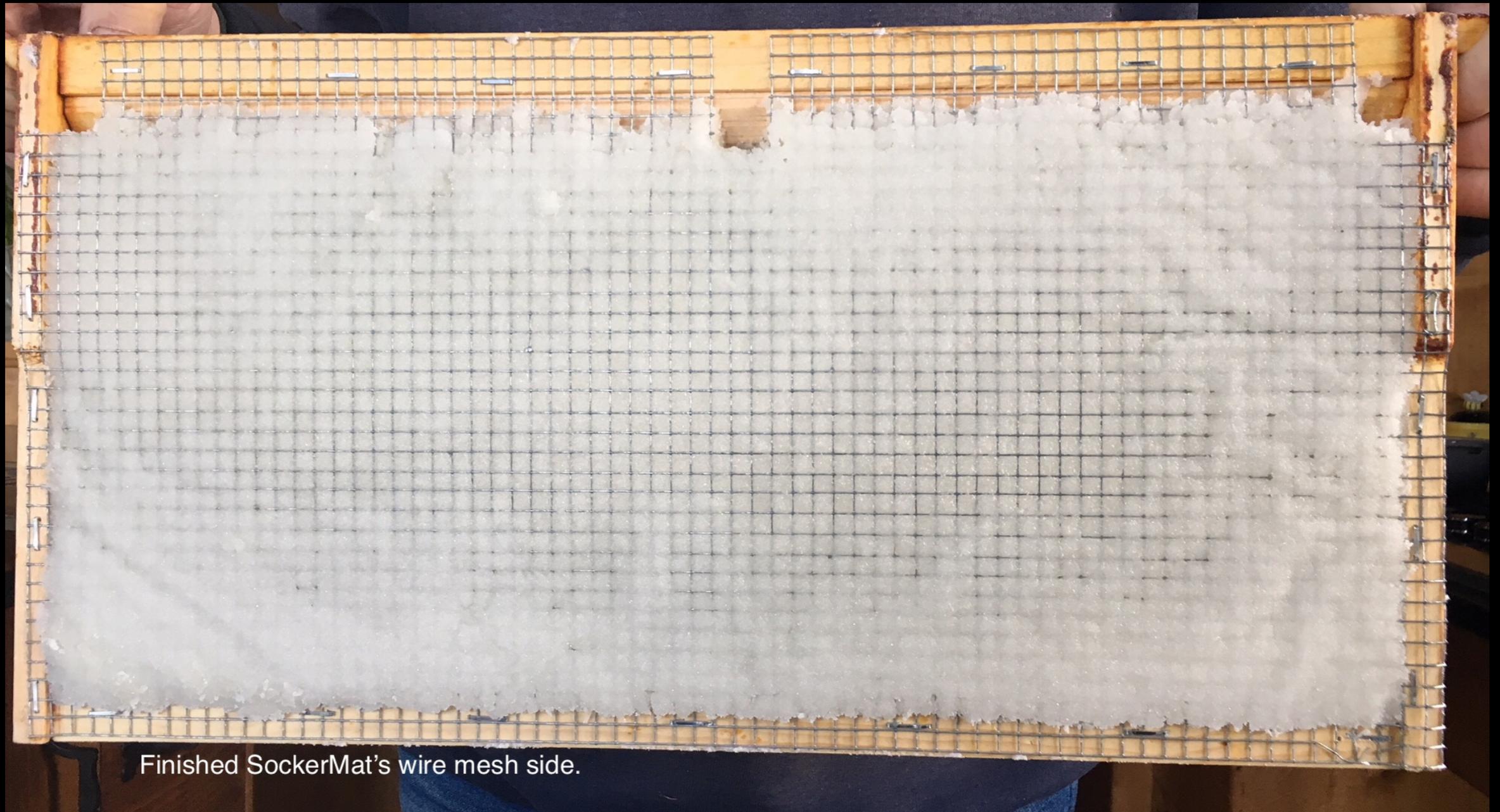
Designed as a colony's supplement feed.

Created by The Beekeeper's Carpenter: The Right Hand LLP
for your honey bees' needs.

Hiking trails

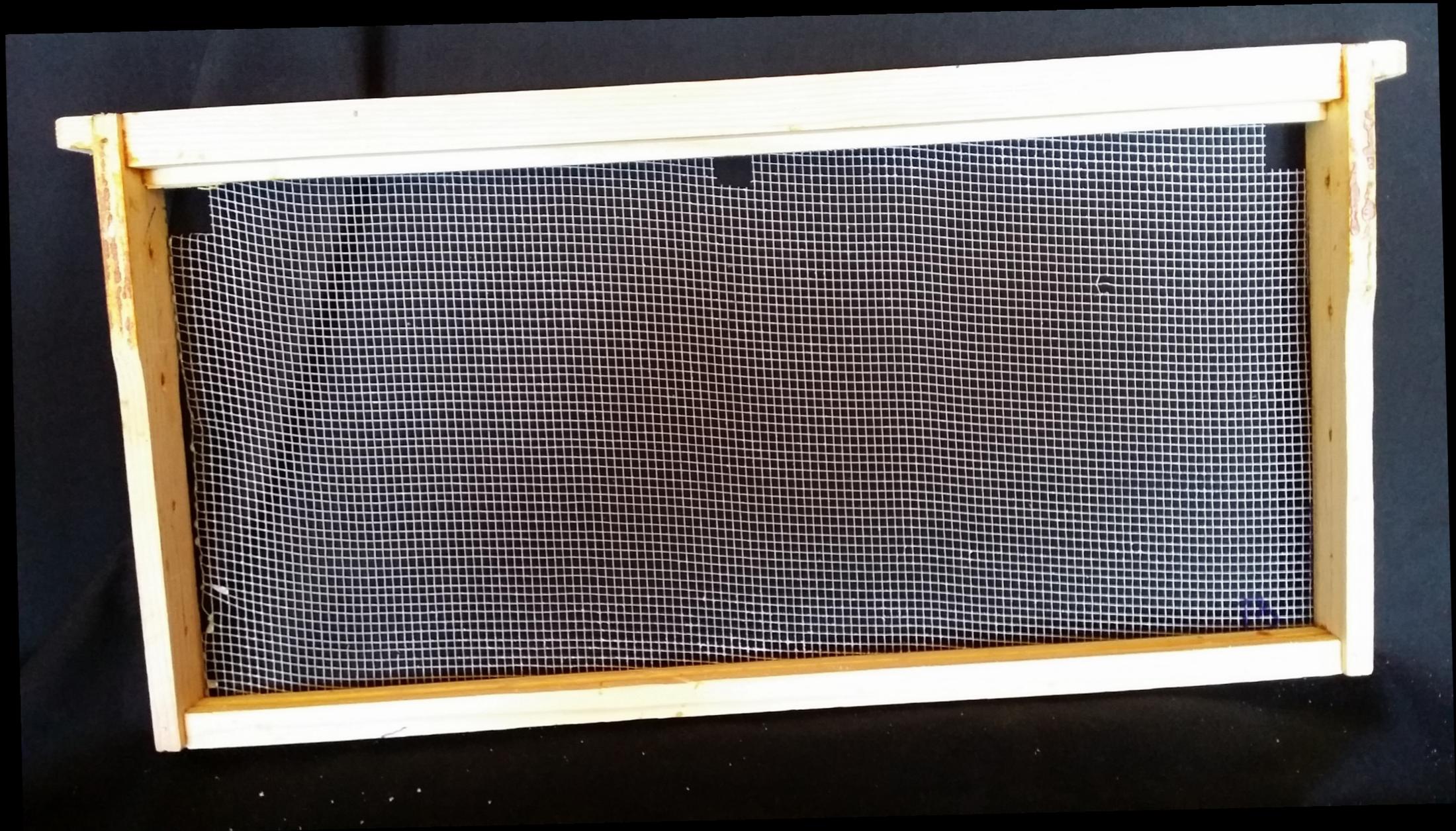
SocketMat





Finished SockerMat's wire mesh side.

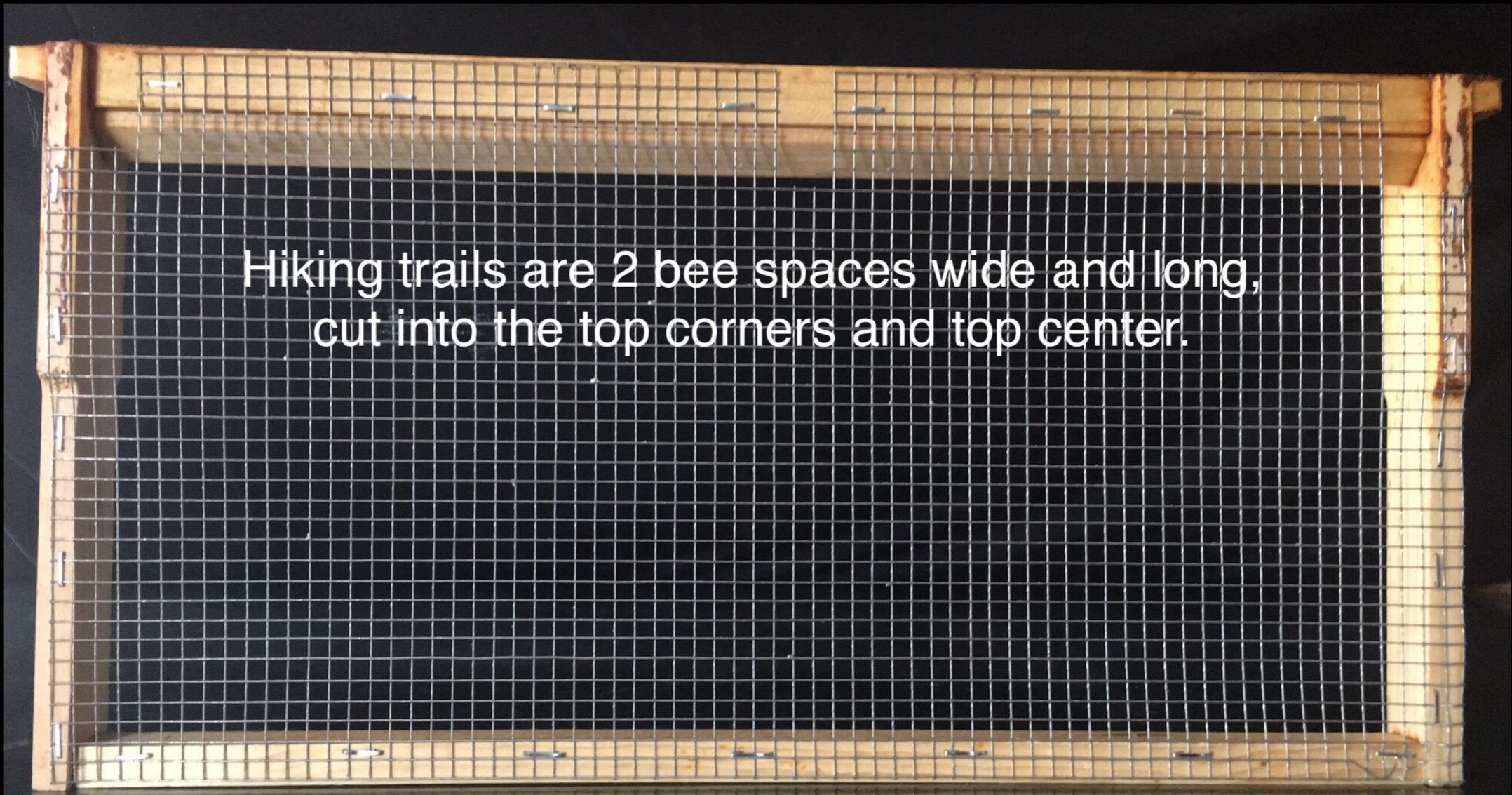
A Socker Mat's backside with the wire mesh.
This shows that 1/4" wire mesh could also be utilized.



The front side of a SockerMat frame with 1/8" wire mesh. Hiking trails are provided along the warmest part of the frame where bees can move during cold spells.



Hiking trails were created by honey bees at the top of their drawn comb. These bee-preferred trails allow them to access the frame's other side during colder temperatures. Recommended: Honey bees may benefit if plastic foundation had trails carved out by their steward.



Hiking trails are 2 bee spaces wide and long,
cut into the top corners and top center.

A SockerMat is designed for any sized hive frame including top bars or frames without bottom bars. Create a folded wire-mesh cradle to support those ends and bottoms, and the thickness of the given top bar. Secure mesh with staples to the frame. Use 1/8" mesh.



SockerMat in hive 1 month. Photograph by Sandra Carnet in Georgia.

This is a SockerMat trialed by a colony of honey bees.
Was it eaten or hauled out as trash?



SockeMat devoured by hungry honey bees.
Photograph by Sandra Carnet

The sugar had to be consumed by the bees since outside temperatures were consistently too cold for the colony to haul the contents from the hive as trash.



Utensils and sugars to make a SockerMat.

A SockerMat recipe does not use thermal treatment resulting in no HMF.



Prepare a flat worksite with a towel and parchment before placing the SockerMat frame.



Add water to measured sugar and
mix with clean hands.

2-1/4 cups cane sugar = 1 pound
3 Tablespoons water per pound of sugar

Dry Never Wet

The sugar-water mix will be the consistency perfectly matched for sandcastle sculpting.





Scoop handfuls of sugar mix onto the SockerMat frame.

Use rollers to compress the sugar mix.



Hiking Trails

Punch out the 3 hiking trails.
Compress the removed
sugar in another location on
the SockerMat frame.



Real Pollen for a Protein Supplement

Protein is not necessarily a beneficial supplement to the colony.

It is important to source real pollen from a reliable provider.



Real Pollen for when Protein is needed.

5 Tablespoons
real pollen ground

+

1 teaspoon water





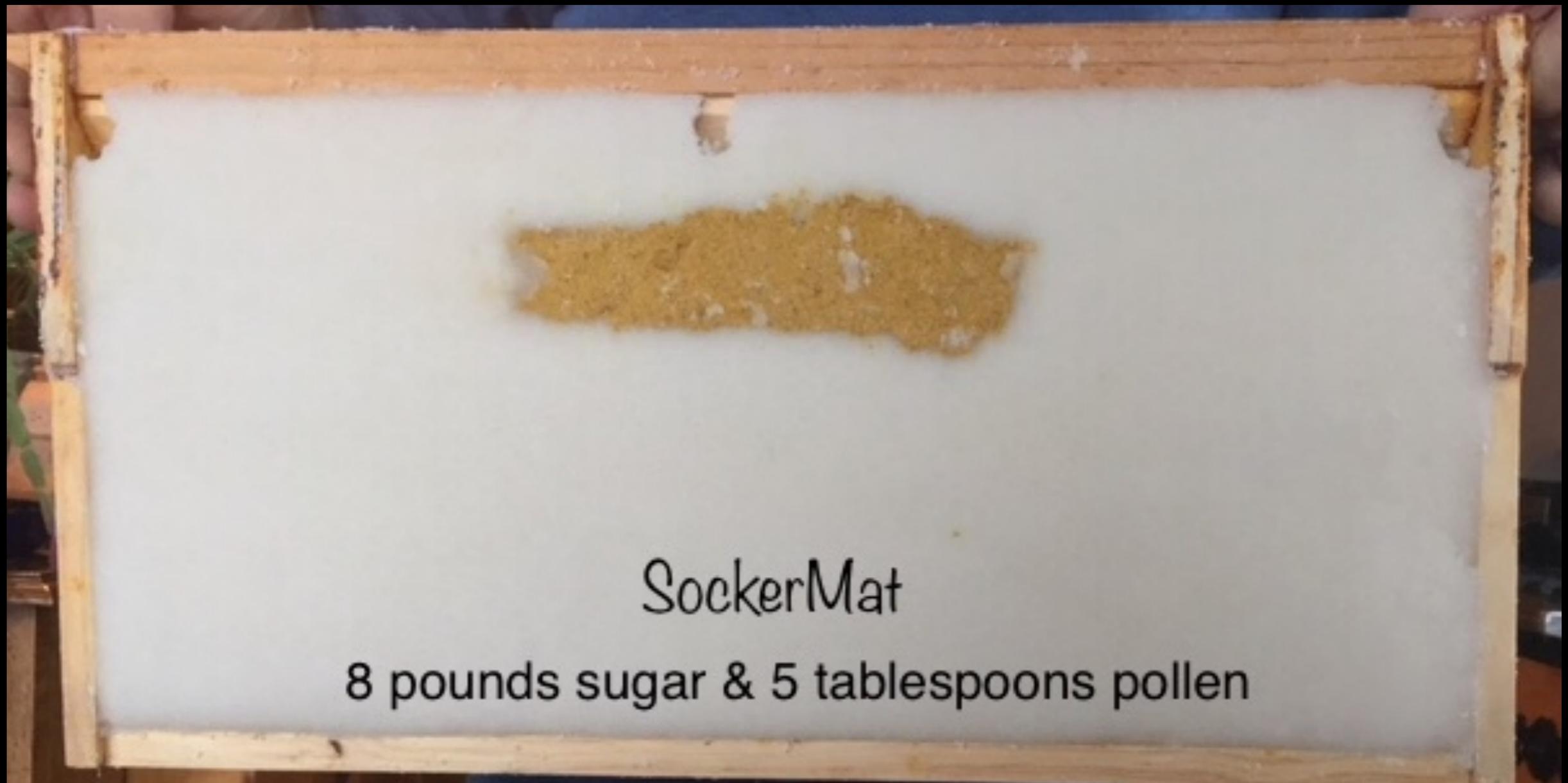
For the pollen option,
scoop out sugar from the top center.

1" wide x 6" long x 1/2" deep

Compress the removed sugar back onto the frame.



The pollen can be gently compressed
in place
with a roller or your fingers.



No Reason to Wait for the Dry.

A SockerMat of compressed sugar can go straight from your worksite to the colony's hive.



A finished SockerMat can dry overnight
on top of an empty frame.



No food

No money

please

HELP

FYI

- Ummay Mahfuza Shapla, Md. Solayman, and Siew Hua Gan. 2018 5-Hydroxymethylfurfural (HMF) levels in honey and other food products: effects on bees and human health. *Chemistry Central Journal*. 19 Jan 2019 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5884753/>
HMF used as a supplement in food does compromise colony fitness but may not cause great losses of brood. It is hypothesized that HMF causes bees to experience dysentery-like symptoms and ulcers in the gastrointestinal intestinal tract, leading to their death
- Keith D. Waddington. Aug 1990. Foraging profits and thoracic temperature of honey bees (*Apis mellifera*). *Journal of Comparative Physiology B*. 31 Dec 2018 <https://link.springer.com/article/10.1007/BF00302599>.
While drinking 40% & 60% solutions bees maintain 97.34° F. thoracic temperature ~ the same high level as upon arrival. Bee drinking 10%, 20%, & 30% solutions regulated 92.3° F. thoracic temperature lower. All bees departed feeder for the hive at the same 96.98° F thoracic temperature. Time to takeoff was 2-3 times longer for bees that ingested 10% & 20% solutions because warmup preceded takeoff. Bees maintained thoracic temperature 97.34° F while drinking 40% & 60% solutions. While drinking 40% & 60% solutions, bees maintained thoracic temperature at ~ the same high level.
- Once sugar is inverted, fructose can dehydrate and form hydroxymethylfurfural (HMF). Inversion is expedited when heat is accompanied by an acid catalyst e.g., cream of tartar, vinegar, lemon, etc. HMF forms slowly during longtime storage but quickly increases with heat.