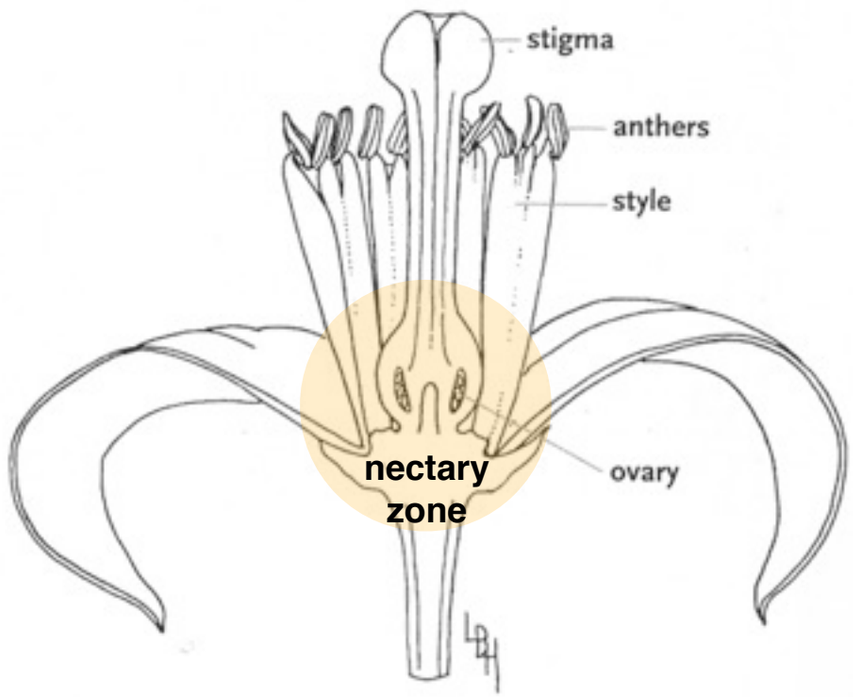
beempathy

enriching human experience of the natural world through beekeeping

“For the sense of smell, almost more than any other, has the power to recall memories and it's a pity we use it so little.” *Rachel Carson*

apoidea

bee's value to ecology: diversity



What is pollination? The exchange of plant genetic material in the form of pollen to maintain genetic diversity within plants of the same species important to ecological health by disease resistance.

-Pollinators provide reproduction **75%** of flowering plants globally

-Plant-pollinator mutualisms are believed to be heavily responsible the flourishing of new flowering plants about **90-140 million years ago**.

- Ecologically speaking, fruits and seeds derived from insect pollination are a major part of the diet of approximately **25 percent of birds, and of mammals** ranging from deer mice to grizzly bears.

Which came first: the bee or flower?

- Researchers believe bees may pre-dated the modern evolution of flowers by at least 100 million years (220 mya Petrified Forest excavation nest remains) but they were not intimately a force of evolution for the flower till at least **90 million years ago**.

- In many plant species, close connection exists between flower color and the kinds of colors bees are able to see indicating plants may have **evolved to attract and appease foraging bee species**. .

Bees are the ultimate pollinating machines!

-Bees, unlike wasps, are **purely gatherers** that rely plant pollen for complex proteins and nectar for energy-filled carbohydrates. Unlike their relatives, the wasps, they are **NOT carnivorous**.

-Many bees are ***opportunistic f*oragers** so gather from many different plants. Some are ***oligolectic*** and gathering pollen from only plant solely. A small number of plants produce nutritious floral oils rather than pollen, which are gathered and used by oligolectic bees.

-Most bees are fuzzy and carry an **electrostatic** charge, which aids in the adherence of pollen. Female bees pack the pollen into the **scopa**, or pollen-carrying hairs that grab and hold the pollen on their legs or back.

friendlier than wasp pollination

bee's economic value to mankind

Andrena "mining" bee working an **apple** blossom.

Apis m. "honeybee" bee working **blueberry** blossom

One in Every Three Mouthfuls

- An estimated **35%** of the global production of plant-based food comes from crops that benefit from animal pollination or **ONE IN EVERY THREE MOUTHFULS** we eat.

- Bees are by far the most important pollinators in agricultural settings and contribute between **$5.7 to $19 billion** per year to the United State economy *(Levin 1983; Robinson et al. 1989a,b; Southwick and Southwick 1992; Morse and Calderone 2000) and $217 billion per year globally (Gallai et al., 2008).*

-The most widely-used bee for crop pollination is the European **honey bee, *Apis mellifera***. Honeybees are considered to be ideal pollinators in many crop systems since each colony produces **thousands of foraging workers** and colonies can be **moved into orchards** and fields during the flowering period. They are especially important pollinators in **large scale, highly disturbed agroecosystems.**

Common Bee-Pollinated Crops

*okra, kiwifruit, **onion**, cashew, custard apple, **celery**, starfruit, brazil nut, **beet**, mustard, rapeseed, **broccoli, cauliflower**, cabbage, brussels sprouts, turnip, canola, chili peppers, **bell peppers**, papaya, safflower, caraway, chestnut, **watermelon**, tangerine, tangelo, coconut, coffee, coriander, hazelnut, cantaloupe, **cucumber, squash**, quince, lemon, lime, **carrot**, persimmon, oil palm, cardamom, loquat, **buckwheat**, fig, fennel, **strawberry**, cotton, **sunflower**, walnut, flax, lychee, macademia, **apple**, mango, alfalfa, opuntia, passion fruit, avocado, **beans**, allspice, apricot, **sweet cherry, plum,** almond, peach, guava, pomegranate, **pear**, rose hips, boysenberry, **raspberry, blackberry, elderberry**, sesame, **eggplant**, citrus, tamarind, cocoa, clover, **blueberry,** cranberry, broad bean, cowpea, **tomato***

honeybee vs. wild “native” bee

decline of honeybee as single source dependency

-The progressive decline of honey bee populations in North America over the past 50 years and the dramatic loss of honey bees due to colony collapse disorder (CCD) in 2007 ***suggest that the exclusive reliance of agricultural pollination on one bee species remains extremely risky.*** *(Committee on the Status of Pollinators 2007; Aizen & Harder 2009), (Oldroyd 2007; Van Engelsdorp et al. 2007)*

wild bees as alternative pollinators

-Native bees (+/- **4000 species of bees that are native to North America**) play an important, but **underappreciated**, role in crop pollination. The economic contribution of our native bees to agricultural pollination is almost certainly high, but has rarely been quantified although conservatively estimated around $3 billion in the US alone. Pennsylvania is home to over **300-400 bee species**. (*Winfree et al. 2007, Ricketts et al. 2004, Kremen et al. 2002).*

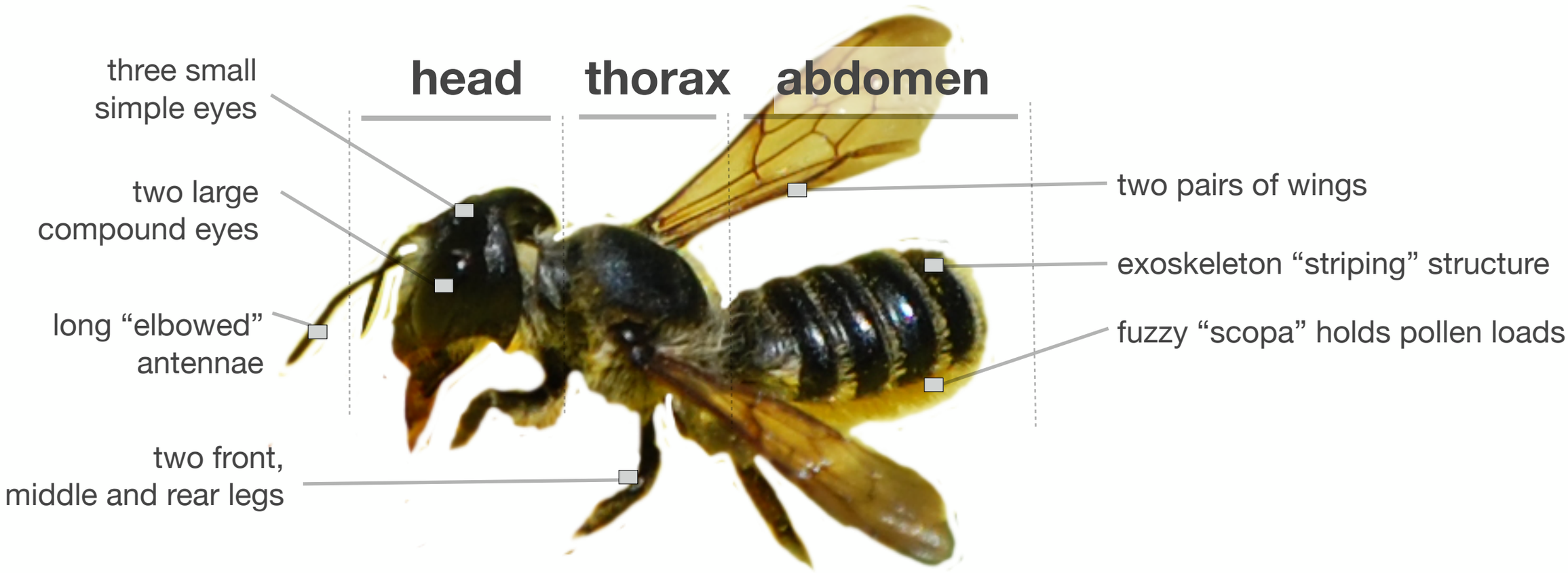
-Wild bees pollinate a variety of crops, including ***apples, pears, nuts, strawberries, tomatoes, peppers, blue- berries, squash, and melons.*** In areas of Pennsylvania, wild bees already provide the majority of pollination for some summer vegetable crops.

- **Collectively, native bees are more versatile than honey bees.** Some species, such as **mason bees, are active when conditions are too cold or wet for honey bees**. Native bee species **forage for longer time periods** between morning and evening compared to honeybees. Many species also are simply **more efficient at moving pollen** between flowers. Bumble bees and several other native species can **buzz pollinate flowers** – vibrating the flower to release pollen from deep inside the pollen-bearing anthers – which honey bees cannot do. ***Crops such as tomatoes, cranberries, and blueberries produce larger, more abundant fruit when buzz pollinated.*** Honey bees are also known to **forage more aggressively** in the presence of native bees.

- Native bees can much easier and less expensive to accommodate than honeybees in terms of **co-habitating in urban and suburban environments** with agricultural zoning issues mainly due to the fact that honeybee nests can be defensive. Native bee nests are all much smaller and native bees ***do not sting as aggressively (if at all)*** to defend their territory. Urban environments may also provide a richer source of crop forage diversity than monocultural agricultural fields and grass lawns with incorporated clover provide great cover crop if not treated.

general characteristics of bees

- **four wings** (two pair)
- **large, wide-set eyes** with **three small eyes** (or “ocelli”)
- **hairy-bodied**, with multi-branched hairs for carrying pollen
- **carry large loads of pollen**, either in a “scopa”
- **size : +/- 1/8” to +/- 1”**
- **color :** black, brown, orange, yellow, red, or metallic blue, green, or copper
- **abdominal stripes** due to body color (exoskeleton) or hair colors



scientific classification of the bee

Kingdom : Animalia

↓

Phylum : Anthropoda *jointed appendages*

↓

Class : Insecta *six-legged, tripartite body*

↓

Order : Hymenoptera *membrane wing*

↓

Superfamily : Apoidea *20,000 species worldwide*

↓

Family	**Family**	**Family**	**Family**	**Family**	**Family**
Andrenidae	Apidae	Colletidae	Halictidae	Megachilidae	Melittidae
mining bees	*bumbles, carpenters, honeybees*	*polyester bees*	*sweat bees*	*leafcutters, mason bees*	*oil-collecting bees*

bee families by nesting preference

Solitary Nesters

-**90% of bee species are solitary nesters** defined by each female constructing and provisioning her own nest without help from other members of her species.

- Solitary nesters live for about a year although they are only active as **adults three to six weeks**. The rest of the time is spent in the developmental stage from egg to cocoon.

-Among solitary bees, lifetime reproduction is among the lowest of all insects, as females of such species to produce typically fewer than 25 offspring

Eusocial “Communal” Nesters

- Social bees live in **colonies,** which are defined as having at least **two adult females** which function collectively as a **superorganism.**

- Social nesters include honeybees (genus Apis), bumble bees and 200 + species of sweat bees.

-Research suggests bees have a keen sense of advantage when to be communal or solitary. 50 North American bee species routinely switch strategies depending up environment.

Solitary Nesting Families

Family
Andrenidae

mining bees

Family
Colletidae

polyester bees

Family
Megachilidae

leafcutters, mason bees

Family
Melittidae

oil-collecting bees

Semi-Communal Nesting Families

Family
Halictidae

sweat bees

Family
Apidae

bumblebees, carpenter bees, honey bees

inside the eusocial bee hive

*-A honeybee **queen** may lay **2000 eggs per day** during spring buildup, but she also must lay **1000 to 1500 eggs per day** during the foraging season, mostly to replace daily casualties, most of which are workers dying of old age.*

- Apis m. honeybee hives contain typically 30,000 - 60,000 bees per colony

-Honeybee hives are approximately 90-99% female with a complex caste system that includes housekeeping bees, nurse bees for brood rearing, undertaker bees, guard bees, resource processing bees and foragaing bees. Their genetics alter to assume different roles throughout their average 6 week life span.

inside the eusocial bee hive

bee + beekeeper relationship

“The bee's life is like a magic well: the more you draw from it, the more it fills with water”

Bees: Their Vision, Chemical Senses and Language
Karl Von Frisch

beempathy : sense of smell

*-Honey bees (Apis mellifera) have **170 odorant receptors**, the researchers found, compared with 62 in fruit flies (Drosophila melanogaster) and 79 in mosquitoes (Anopheles gambiae). Instit. for Genomic Biology*

=Researchers in Croatia trained a team of honey bees to sniff out landmines by making them associate the smell of TNT with sugar (poor bees). Their super sniffing power means they can detect odours from up to 4.5km away.

beekeeper : heightened scent development

Seasonal Flora Tracking

- Just for the total delight of the good smells after long winters

- Spring shrubs very fragrant : crabapples, black locust, basswood

- To get a sense of incoming hive forage during flows (knotweed)

- Seasonal bloom cycles tracking climate change trends.

http://honeybeenet.gsfc.nasa.gov/

Less invasive hive health monitoring

- Good smells indicate balance, like the sweet smell of brood “baking” due to beebread in the hives being fed to developing larvae. Bee Bfread contains fungi, amino acids, enzymes, proteins, lipids, yeasts and different types of bacteria, as well as minerals and vitamins.

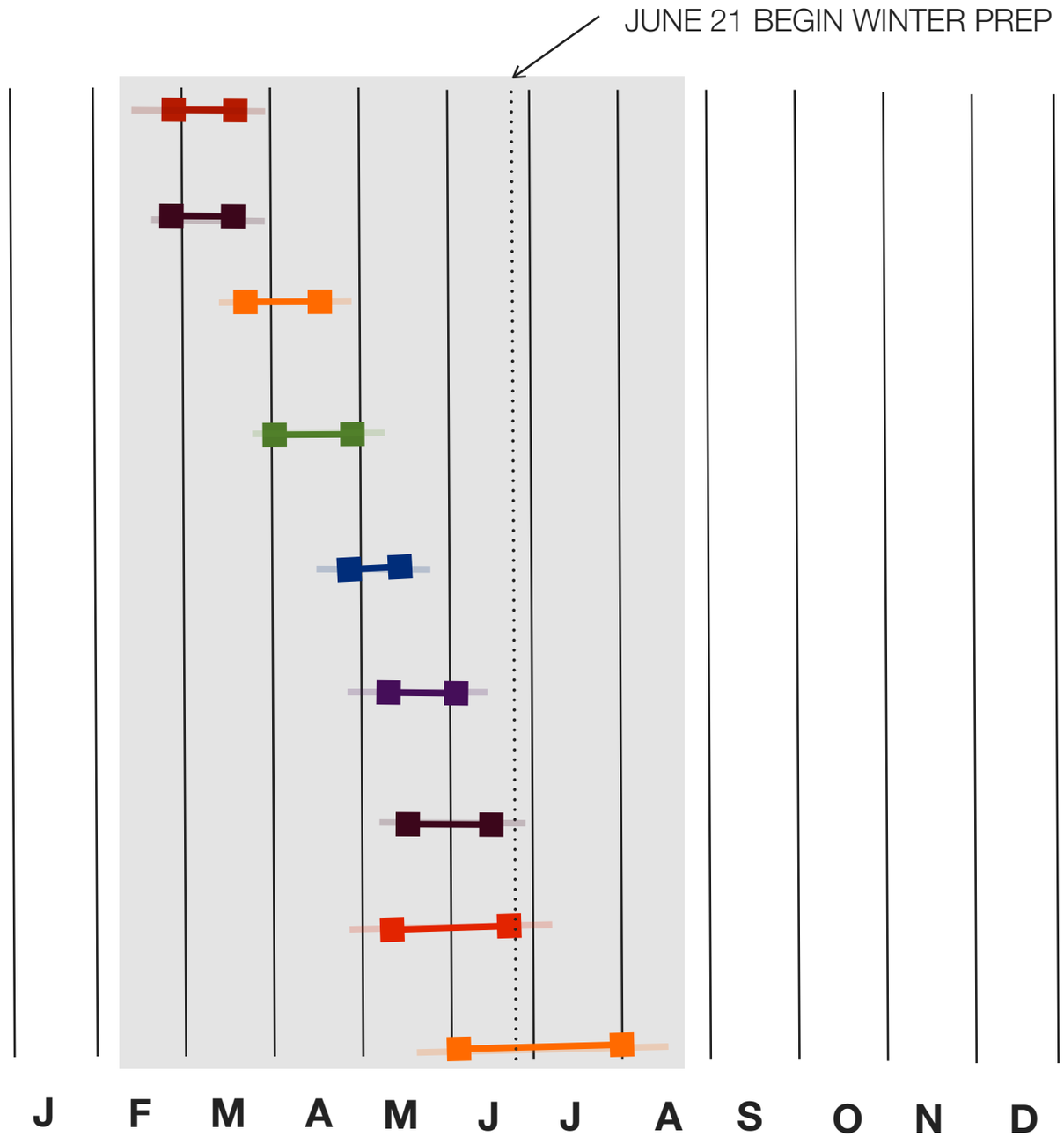
- Disease warnings. American Foulbrood Bacteria, Fungal infection.

The scent organ for bees is the antennae.

seasonal bloom timing

Western Pennsylvania Trees

- **RED MAPLE**
- **PUSSY WILLOW**
- **SERVICEBERRY**
- **APPLE, PEAR, CHERRY**
- **LOCUST, BLACK**
- **CHOKECHERRY**
- **BASSWOOD/ LINDEN**
- **TULIP POPLAR**
- **STAGHORN SUMAC**



BLOOM TIMING PER GROWING CYCLE VARIES GREATLY RELATED TO MANY FACTORS INCLUDING RAINFALL, AVERAGE TEMPERATURE, AND MICROCLIMATE VARIATIONS DUE TO TERRAIN AND HEAT ISLAND EFFECT.

beempathy : sense of taste

-Gustatory sensilla are mostly located on the *distal segment of the antennae, on the mouthparts, and on the tarsi of the forelegs.*

-Sensilla respond with varying sensitivity to sugars, salts, and possibly amino acids, proteins, and water.

-When bees are free to express avoidance behaviors, *they reject highly concentrated bitter and saline solutions.*

Taste Perception in Honey Bees: Chem. Senses (2011) May 26, 2011

bees taste with their mouths, antenna and feet.

beekeeper : heightened taste development

Deciphering nuances in honey

- Warm ripened honey straight from the hive has life and flavor complexities far beyond store purchased processed “Grade A” that might be overheated and filtered

- Honeys have vintages per growing season. No batch has ever been exactly alike, particularly in Western PA where the forage is diverse and varies throughout the growing season.

beempathy : sense of sight

The two big eyes on a bee are called **compound eyes** because they are made up of thousands of tiny lenses. Each lens (called a **facet**) sees a small part of a scene and, all together, the lenses form an entire picture.

The three other eyes are called simple eyes or **ocelli**. These eyes don't see images but can detect light, especially changes in light. They are used to navigate the low light levels at the interior of a hive.

The visible spectrum of a bee is shifted when compared to the visible spectrum of a human. The visible spectrum is "shortened for the bees in the red, but it is extended into the ultraviolet," a color that a human with normal vision can not see (Frisch 9)."

Bees use the sun as a compass. But when it's cloudy, there's a backup, they navigate by **polarized light** using special photoreceptors to find the sun's place in the sky.

bees have two compound and three simple eyes

beekeeper : heightened sight development

Scanning the hive

- keen eyesight required to scan hive for viability related to queen health, from queen position to egg distribution

Scanning the horizon

- keeping a broad view perspective on blooming trends to sense when peak blooms are coming on. Black Locust fills Panther hollow for a week or two in the spring.

beempathy : hearing + touch

The “fuzziness” of bees helps not only to pick up pollen and insulate their bodies but also to sense

Hives are very sensitive to vibration and areas of built comb are often “propolized” with tree resin to help dampen vibrations and keep the colony calm.

In order to release the pollen, bumblebees and some species of solitary bees are able to grab onto the flower and move their flight muscles rapidly, causing the flower and anthers to vibrate, dislodging pollen. This resonant is called *buzz pollination*.

beekeeper : heightened hearing + touch

keeping zen

-Gentle slow movements are required to not disturb a colony which requires the beekeeper to be calm as well.

humming tone

- Listening closely to a hive lets the beekeeper know if things are working smoothly and the hive is queenright. If stuttering or “piping” noises are heard, it usually indicates there is disorder and distress.

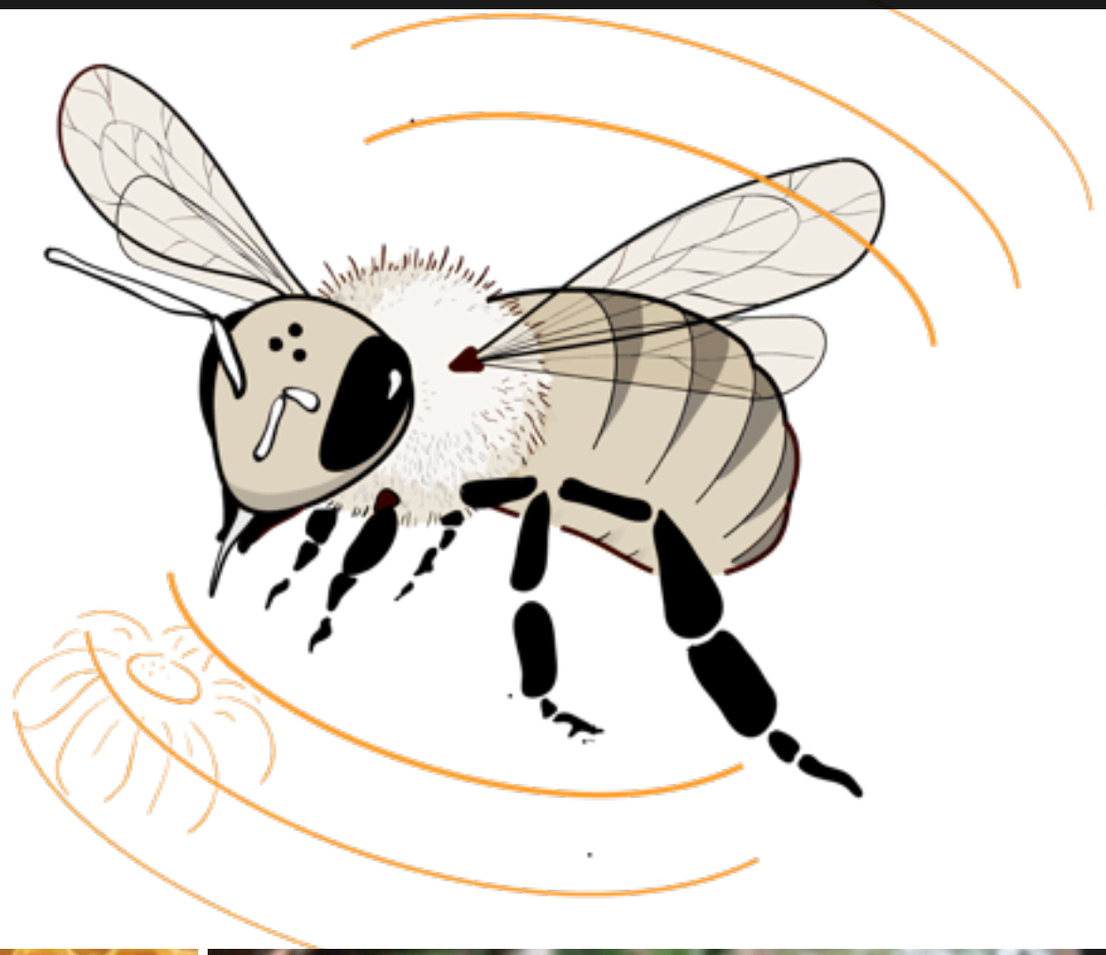
incoming weather

- If all hives in a yard seem agitated, better check the radar! Rain is likely coming.

beempathy : 6th sense- intuition

- How do eusocial hives decide where to swarm?
Bees use the `**weighted additive strategy"** nicknamed *Honeybee Democracy*. Despite being composed of small-brained bees, swarms are able to use the weighted additive strategy by distributing among many bees both the task of evaluating the alternative sites and the task of identifying the best of these sites."
Section of Neurobiology and Behavior, Cornell University Ithaca, NY 14853, USA

- Bees are amazing natural builders and produce the primary building material for their hives, drawn comb, by accurately sculpting wax secretions from glands on their abdomen.



beekeeper : heightened intuition

Teamwork

- Group evaluation for problem solving technique

Anticipating hive fluctuations

- using all senses sometimes not possible to glean information when deciding whether to disturb the hives and perform routine or emergency management. Sometimes one just has to go for it if it's sensed something is wrong with the hive.

bee protection resources

Organizations

Xerces Society www.xerces.org

Pollinator Partnership www.pollinator.org

Bee Friendly Farming Program www.pfspbees.org

Free Online Resources

Pollinator Conservation Resource Center
Bring Back Pollinators Campaign
www.xerces.org/pollinator-resource-center

Wild Pollinators of Eastern Apple Orchards and how to conserve them
http://www.northeastipm.org/park2012

Pollinator Partnership
Selecting Plants for Pollinators
Eastern Broadleaf forest
www.pollinator.org/PDFs/EasternBroadleaf.Oceanic.rx18.pdf

Free App

Bee Smart Gardening App - Pollinator Partnership

Publications

Bringing Nature Home Douglas W. Tallamy

Attracting Native Pollinators Xerces Society Guide

Native & Organic Garden Plant Suppliers

Earnst Xerces Mid-Atlantic Pollinator Seed Mix

Partnership between Earnst, NRCS (Natural Resource Conservation Service, PSU and Xerces to develop pollinator mixes for 08' Farm Bill's Conservation Program

Sylvania Natives www.sylvanianatives.com

Grow Pittsburgh www.growpittsburgh.org

increasing bee forage

-Use local native plants. Research suggests native plants are four times more attractive to native bees than exotic flowers. In gardens, heirloom varieties of herbs and perennials can also provide good foraging.

-**Choose several colors of flowers.** Flower colors that particularly attract native bees are blue, purple, violet, white, and yellow.

-**Plant flowers in clumps.** Flowers clustered into clumps of one species will attract more pollinators than individual plants scattered through the habitat patch. Where space allows, make the clumps four feet or more in diameter.

-**Include flowers of different shapes.** Bees are all different sizes, have different tongue lengths, and will feed on different shaped flowers. Consequently, providing a range of flower shapes means more bees can benefit.

-**Have a diversity of plants flowering all season.** By having several plant species flowering at once, and a sequence of plants flowering through spring, summer, and fall, you can support a range of bee species that fly at different times of the season.

SPRING

Willow *Salix*
Redbud *Cercis*
Squill *Scilla*
Serviceberry *Amelanchier*
Wild plum *Prunus*
Tuliptree *Liriodendron*
Basswood *Tilia*
Blueberry *Vaccinium*
Hawthorn *Crataegus*
Azalea *Rhododendron*

MID-SUMMER

Mountain mint *Pycnanthemum*
New Jersey tea *Ceanothus*
Milkweed *Asclepias*
Spiderwort *Tradescantia*
Sunflower *Helianthus*
Wild rose *Rosa*
Purple coneflower *Echinacea*
Culver's root *Veronicastrum*
Tickseed *Coreopsis*
Cosmos *Cosmos*

GARDEN/ COMPANION

Beebalm *Monarda*
Catmint *Nepeta*
Basil *Ocimum*
Lavender *Lavandula*
Rosemary *Rosmarinus*
Russian sage *Perovskia*

LATE SUMMER / FALL

Sneezeweed *Helenium*
Partridge pea *Chamaecrista*
Hyssop *Agastache*
Blazing star *Liatris*
Ironweed *Vernonia*
Joe-pye weed *Eupatorium*
Goldenrod *Solidago*
Aster *Symphyotrichum*
Beardtongue *Penstemon*

forage landscape strategies

veggie gardening

companion planting & flora as IPM barrier strip

bee lawn

dandelions and clover cover cropping

hedgerow

roadside/ drainage ditch

backyard/urban orchard

rain garden

pesticide use awareness

BUYER BEWARE!

2013 FRIENDS OF THE EARTH REPORT

Bee-Toxic Pesticides Found in "Bee-Friendly" Plants Sold at Garden Centers Nationwide

• Neonicotinoid residues were detected in seven out of thirteen samples (**54 percent**) of commercial nursery plants. In the samples with detections, concentrations ranged from 11 to 1,500 micrograms per kilogram (µg/kg or parts per billion) of plant material.

• The high percentage of contaminated plants and their neonicotinoid concentrations suggest that this problem is widespread, and that many home gardens have likely become a source of exposure for bees.

• For the samples with positive detections, adverse effects on bees and other pollinators are possible, ranging from sublethal effects on navigation, fertility, and immune function to bee death.

Bee Friendly Farming Program

www.pfspbees.org

BEE FRIENDLY FARMING®

S.H.A.R.E. POLLINATOR PARTNERSHIP

Simply Have Areas Reserved for the Environment

Tips for Bee-Caring Growers

1 USE IPM STRATGIES : AVOID PESTICIDES IF POSSIBLE.

2 Check the label of any pesticide for safety to bees. Realize that a number of insecticide/fungicide combinations are more toxic to bees than single ingredients alone!

3 Apply insecticides and fungicides (even "safe" ones!) at dusk or later to **avoid foraging bees.**

4 Avoid spraying fungicides during **crop bloom.**

5 Minimize use of **extended residue** compounds.

6 Target only infested areas for pest and herbicide applications; **avoid overspray**. Be aware that bees can be poisoned when foraging upon flowering weeds in non-flowering crops.

7 Remember that honey bees can easily **forage two miles** in any direction from their hive.

8 Bees and wildlife can be **poisoned by pesticide- contaminated water—keep pesticides out of streams and ditches.**

9 Set aside untilled areas in which native ground- nesting bees can maintain populations.

10 Grow a **diversity of native wildflowers** near crops to provide pollen and nectar throughout the seasons to help provide **balanced nutrition** for bees.

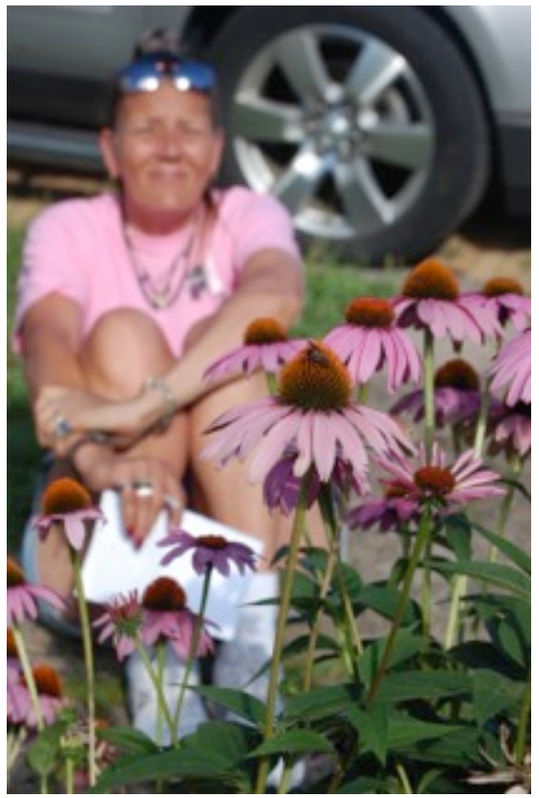
11 The planting of **bee forage in uncultivated areas** can help improve bee (and other beneficial insect) health and populations.

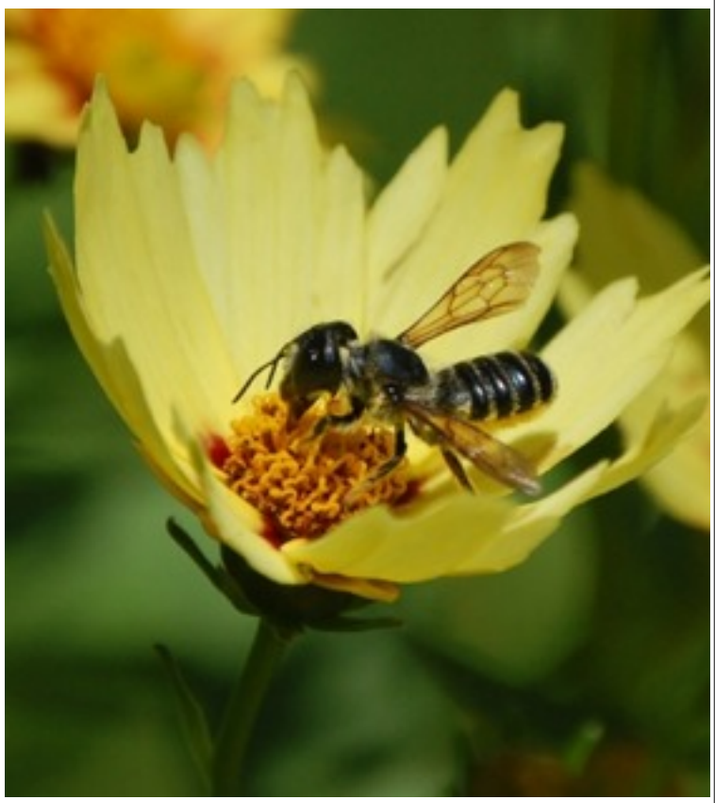
12 ASK! Demand consumer transparency when it comes to know the plants that you purchase. Understand you might be providing a source of unintended toxin for bees .

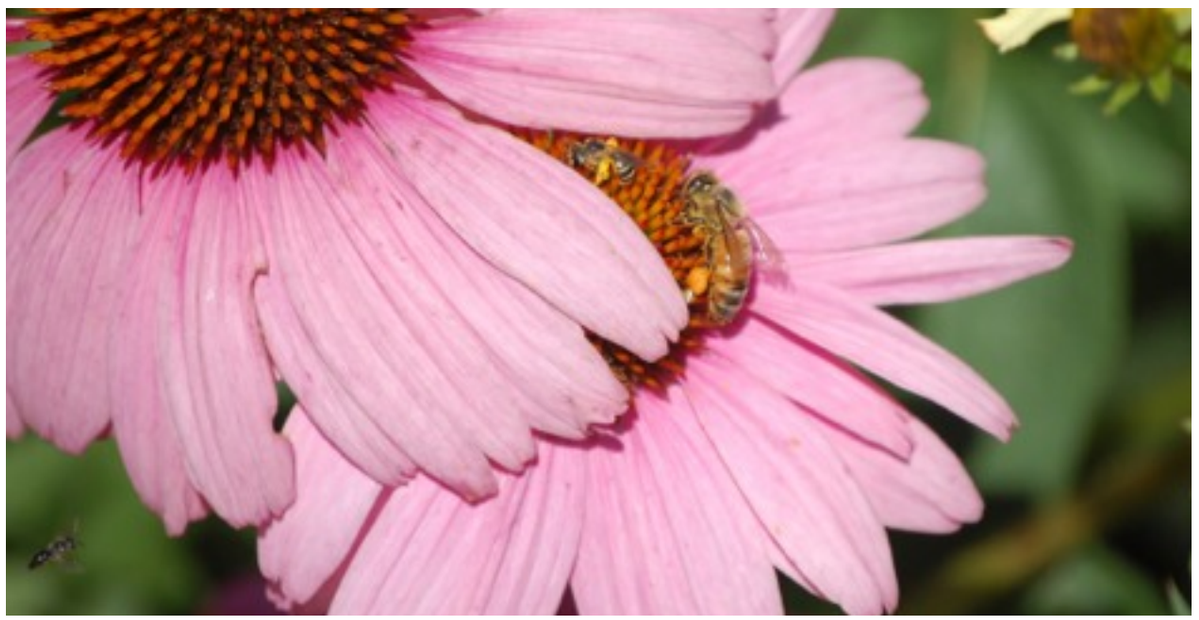
slow down and bee

evaluate your own local pollinators with friends and neighbors!

Gardens of Millvale Monthly Citizen Scientist Pollinator Study.







Certify Your Pollinator Friendly Garden

Penn State Master Gardeners

Does your property already qualify? Fill out the application and send it with a non-refundable $10.00 application fee. If you qualify you will receive a certificate verifying that your landscape is pollinator friendly (see photo above). You will then be eligible for the Penn State Master Gardener Pollinator Friendly Garden sign for $30.00. Both the certificate and the sign show your commitment to conserve pollinator habitat. Your donation also helps support Penn State Master Gardeners continue their quest of educating the public about the importance of providing habitat for pollinators.

Linden Flower “Tisane” bee tea

- take a cluster of about 5-6 basswood flowers as they are just opening up.

-steep in a mug of hot water for 3-5 minutes.

-add basswood honey to taste, only if necessary!

- 10 to 15 clusters per gallon of water makes a good sun tea on warm may days.

apoidea

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#beebloom2014