

New York State



*Bee Wellness
Workshops*

Foulbrood Bee Diseases


EUROPEAN FOULBROOD
AMERICAN FOULBROOD

Healthy Brood- Plump, pearly white



Healthy Brood



- 
- Brood diseases prevent the development of normal healthy replacement adult bees.
 - Both European and American Foulbrood diseases are caused by bacteria.
 - Both can show discolored larvae.
 - Both can create spotty brood patterns.
 - Other brood diseases- Varroa mites, sac brood, chalk brood.

European Foulbrood

- Larvae change color from pearly white to brownish grey
- Larvae die in coiled or twisted positions, usually uncapped
- Dead larvae are watery, not sticky or ropy.
- Dried larval scales are easily removed from the cell
- Some larvae die in capped cells, but are normally not ropy
- Drone and queen larvae are also affected

Transferred by-

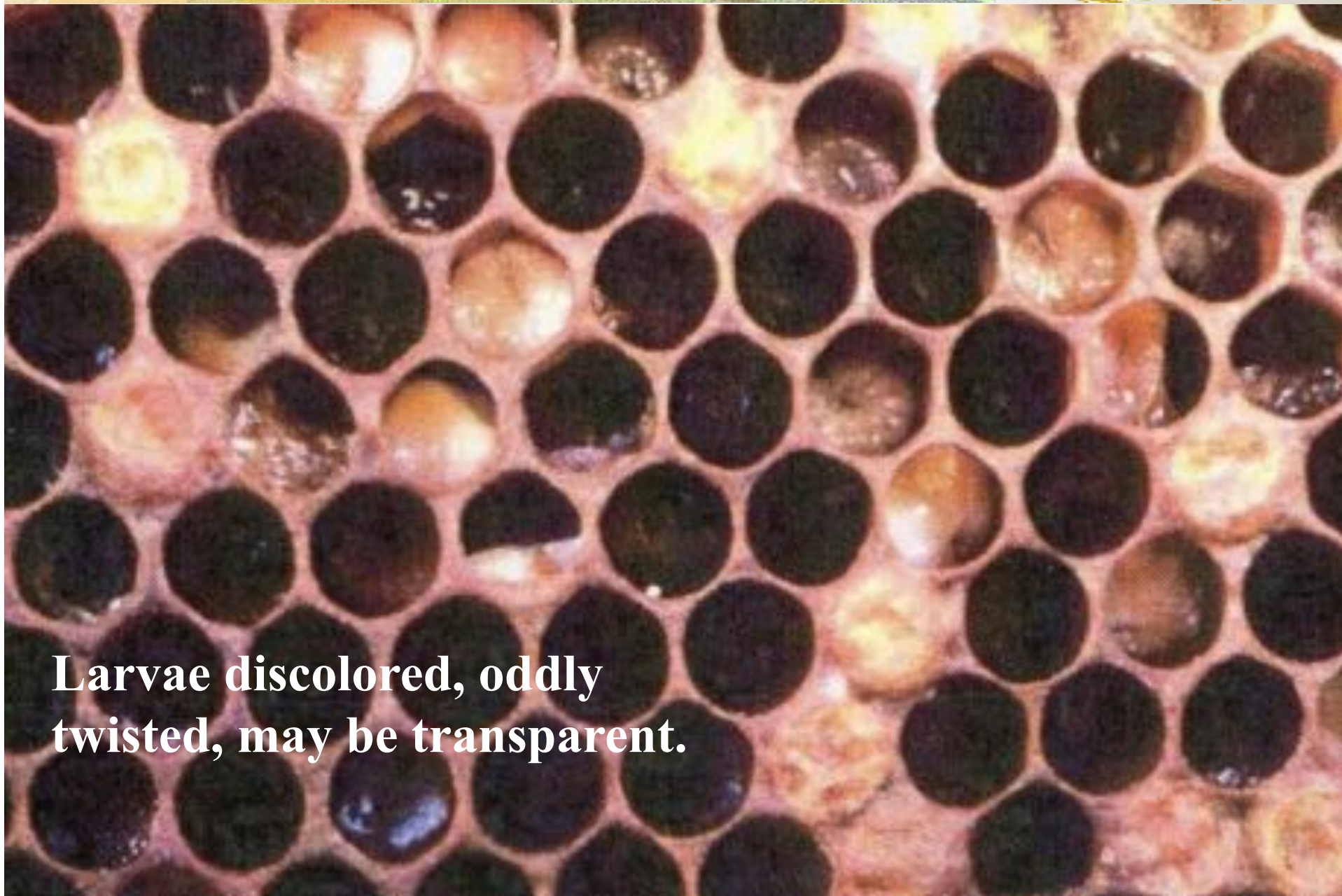
Beekeeper- transfer from an infected hive to a healthy hive.

Robbing of weakened, infected colonies & swarms also spread the disease.

European Foulbrood

- Caused by bacterium, *Melissococcus plutius*
- EFB is common in colonies suffering from other stress.
- Does not produce spores.
- Treatment with Terramycin is effective.
- Breaking brood cycle can allow house bees to clean cells.
- Not as deadly as American Foulbrood; hive may recover.
- Both bacterial foulbrood diseases are widespread, are named based on where they were first studied, not location of origin.

European Foulbrood



Larvae discolored, oddly twisted, may be transparent.

European Foulbrood

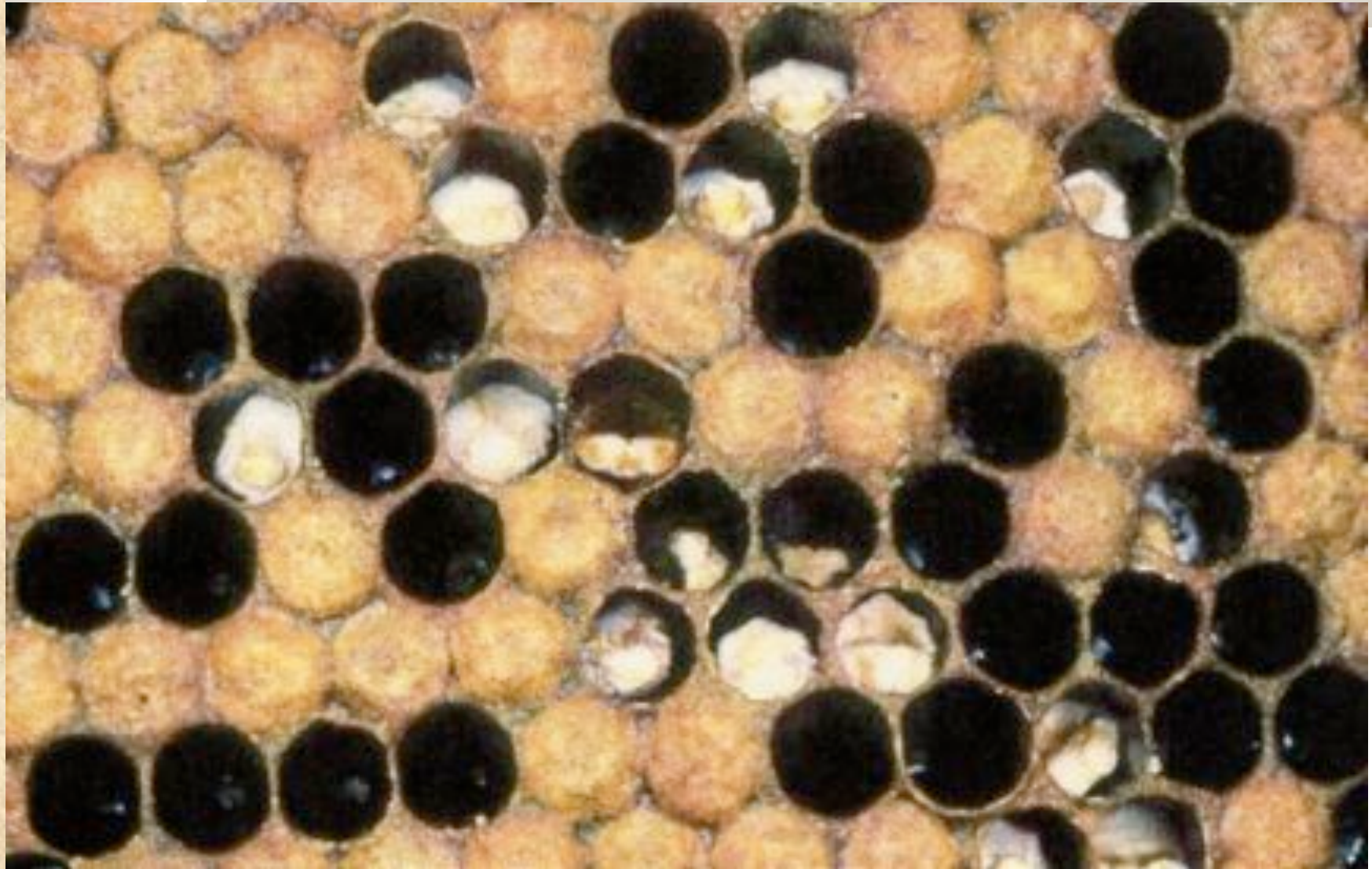


Larvae may lack segmentation

Varroa Mites- spotty brood pattern



Chalkbrood- Fungus; increase ventilation



Sac Brood- virus

The pupae do not develop or shed the last skin which locks in the pupae as it rots, contains fungal spores.



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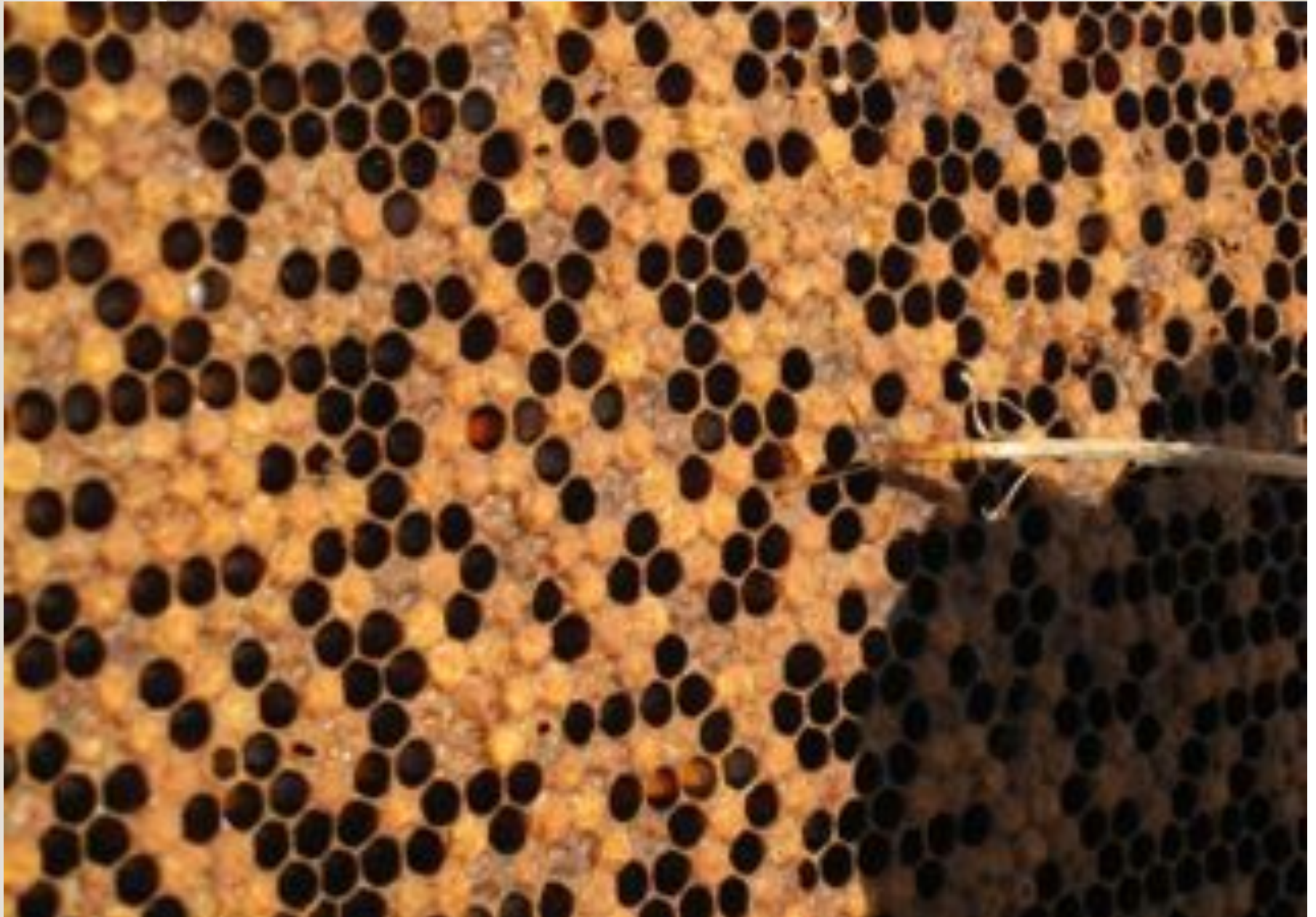


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Foulbrood Bee Diseases

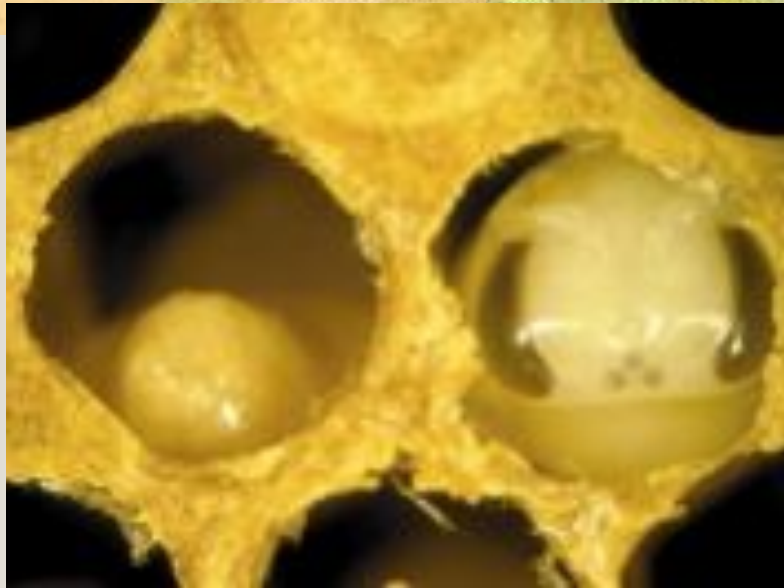
AMERICAN FOULBROOD

AFB- Bacterial Disease of Bee Larvae



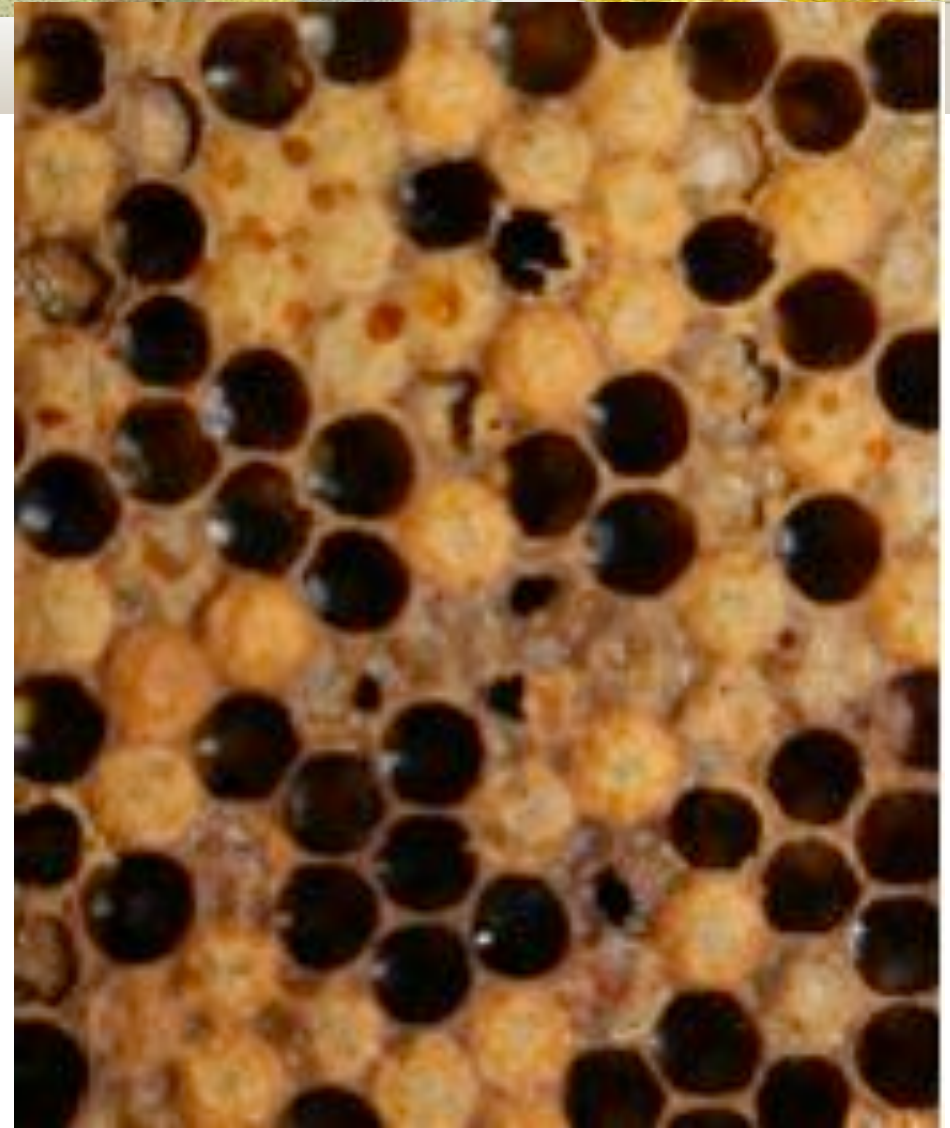
CHARACTERISTICS OF AMERICAN FOUL BROOD

- Most Fatal Brood Disease
- Spotty brood.
- Cappings moist, discolored, sunken.
- Perforations in cappings, from house bee inspection.
- Decayed larvae soft, sticky, ropy when drawn out with a twig.
- Dead larvae brown or black, in upright position in capped cell.
- Dead pupae has tongue (mouthparts) projecting into the center of the cell.
- Scale adheres to floor of cell.
- Stench. Genetically, some people do not smell this.



Infected larva (left) and a healthy dark-eyed pupa (right) of the same age (artificially infected, carefully uncapped)

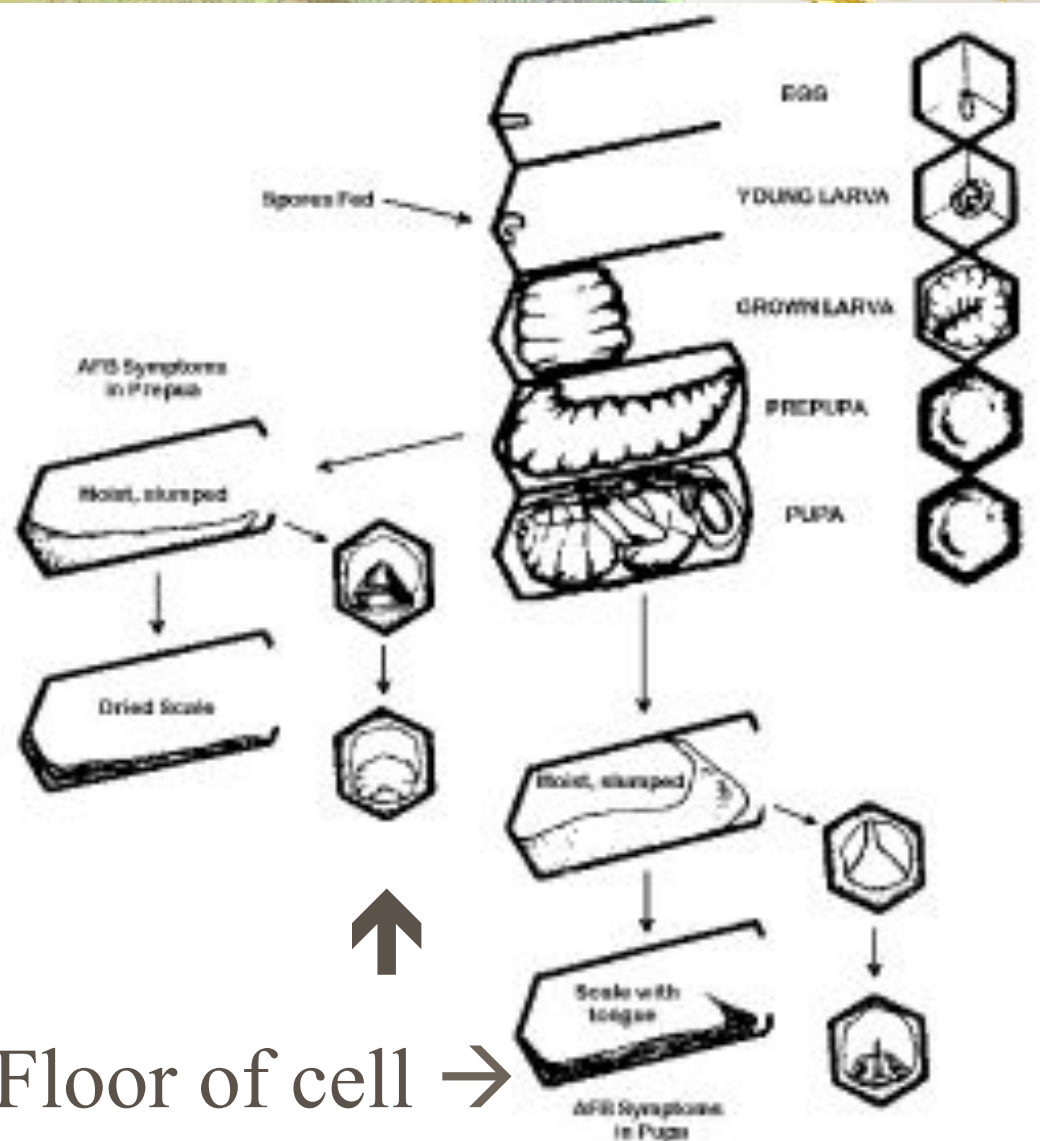
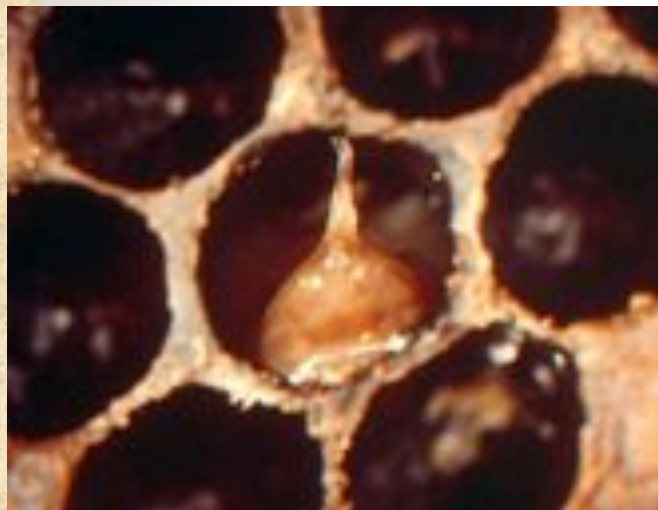
At right, moist, sunken, perforated cappings of infected frame.



CHARACTERISTICS OF AMERICAN FOULBROOD

- AFB caused by a spore-forming bacterium *Paenibacillus larvae*
- Rod shaped vegetative stage and Spore stage
- Spores are the contagious stage, and resistant.
- Larvae up to 3 days old become infected by eating spores in their food.
- Spores germinate and grow into the vegetative form in larvae.
- Kills larva, produces 2 billion new spores per larva.
- Spores remain viable indefinitely (80+ years).
- Extremely contagious, resistant, and spreads easily.

American Foulbrood Development



Floor of cell →

CHARACTERISTICS OF AMERICAN FOULBROOD

- As few as 10 spores per larva can cause mortality
- Larvae die after the cell is capped
- An infected colony will worsen until most brood dies, and no new adult bees are produced. Colony dies.
- An infected colony is never cured.
- Spores remain in honey, pollen, comb, wax.
- Spores spread within colony by house bees.
- Spores remain in cleaned cells; contaminate nectar & honey.
- Adult bees are not sickened by the spores, but transport them.

Spread of Spores Between Colonies

- Robbing from infected hive
- Drifting bees (both worker bees and drones)
- Swarms from infected hive (natural and artificial)
- Honey from infected hive
- Beekeeping tools
- Contaminated equipment

“Shotgun pattern” of brood
in an infected hive →



Diagnosis: American Foul Brood (AFB)

The goo left by AFB killed larva can be drawn to form a "rope" while the larva is still moist.

- This is commonly called a ropiness test.

The dead larva dehydrates, becomes a scale, completely dried, difficult for bees to remove, contains millions of spores.





Diagnosing AFB

- Inspect brood spring and fall. Shake all bees off of brood frame to assure clear view. Look for discolored larvae, discolored, greasy, sunken or perforated cappings.
- Ropiness test- insert rough wood toothpick into a moist suspect larva or pupa. Stir well, then slowly withdraw. A sticky thread 1” long is a strong indicator of AFB. (burn twig to kill spores on it)
- Inspect floor of cell for presence of scale.
- Vita AFB Diagnostic Kit- about 5 minutes, similar in design to home pregnancy tests.
- Holst Milk Test for AFB
- **Send sample to Beltsville Lab! Free, accurate.**

Submit Sample to Beltsville Lab

Samples of Brood

- The sample of comb should be at least 2 X 2 inches and contain as much of the dead or discolored brood as possible. **NO HONEY SHOULD BE PRESENT IN THE SAMPLE.**
- The comb can be wrapped in paper and sent in a heavy cardboard box. **AVOID** plastic, aluminum foil, waxed paper, tin, glass, etc. because they promote decomposition.
- If a comb cannot be sent, the probe used to examine a diseased larva in the cell can be wrapped in paper and sent to the laboratory in an envelope.

Send all samples to:

Bee Disease Diagnosis
Bee Research Laboratory
Bldg. 476, BARC-East
Beltsville, MD 20705
(301) 504-8821

- Include a short description of the problem along with your name and address.
- There is no charge for this service.
- Email: SmithB@ba.ars.usda.gov



Holst Milk Test

- The Holst milk test (Holst 1946) is based on the fact that high levels of proteolytic enzymes are produced by sporulating *Paenibacillus* larvae.
- Place suspect scale or smear of diseased larva in a vial containing a few spoonfuls of powdered milk in water (about 1 part powder to 4 parts water), stir.
- Incubate at 37° C (body temperature; pocket). If AFB is present, the suspension should clear in 10 to 20 minutes. This test is not totally reliable, but is good for how simple it is.
- Preparing an identical vial with no bee tissue provides a good comparison.



Prevention of American Foulbrood

- Check for AFB before making splits or transferring brood comb to hive.
- Do not feed honey or pollen from an unknown source
- Check for AFB in spring and fall
- Prevent robbing
- Position and/or distinguish hives in manner to reduce drifting
- Replace 3 or 4 old brood frames in each brood box each year.
- Sterilize hive tool, smoker, gloves, and hands after working a suspect hive
- Obtain bees from known sources. Bees bred for **hygienic behavior** demonstrate some resistance to AFB, chalkbrood and varroa mites.
- If AFB is present, when antibiotic treatments stop, AFB spores germinate. If your bee source treated with antibiotics in a state where prophylactic treatment is permitted, there may be spores in the old comb.

Prevention of American Foulbrood

- ✗ Do not purchase used combs, which may harbor spores.
- ✗ Disinfect second-hand hives by thoroughly scorching inside with a blow torch, or fire built inside a stack
 - > or immerse in 3% sodium hypochlorite (bleach) solution
- ❑ Hive swarms of unknown origin onto Foundation and do not feed for 3 days. Contaminated honey carried by the bees will be consumed while drawing new comb. Keep isolated for 3 months before combining into regular apiary. If AFB appears, destroy these bees and frames, and treat the woodenware.
- ❑ Treatment with Terramycin or Tylan will prevent spores from germinating in larvae. Does NOT KILL Spores. Treatment must be completed 4 weeks prior to honey flow.



Treatment of American Foulbrood

- If you find a suspect hive-
- Send sample for clinical testing.
- Isolate hive. Change its appearance from that of nearby hives, to reduce drifting, reduce opening to 1 bee width, or screen in and feed syrup.
- DO NOT create infirmary to maintain known AFB hives. They will produce spores and spread the disease.

Treatment of American Foulbrood

- When AFB is verified, **spores are destroyed by burning.**
- Frames, bottom boards and foundation should be burnt.
- Hive boxes, inner covers and lids should be Burnt or thoroughly scorched
 - Build a fire inside a stack of boxes, extinguish after thorough scorching, or
 - Use a torch to thoroughly scorch all insides, especially corners, seams, cracks
 - This is not always sufficiently effective to justify the 'savings'.

Treatment of American Foulbrood

- Hive, honey and pollen can be sterilized by exposure to ethylene oxide gas in a closed chamber, as used for sterilization of hospital equipment.
- Hive can be sterilized by gamma irradiation, which kills AFB and leaves no harmful residue. <http://www.montcobeekkeepers.org/Pages/Irradiation.aspx>
- Woodenware can be sterilized by boiling in lye or boiling paraffin.
- Honey from an infected hive is safe for human consumption (If antibiotics have not been in use) but should not be fed to bees.

Healthy brood →

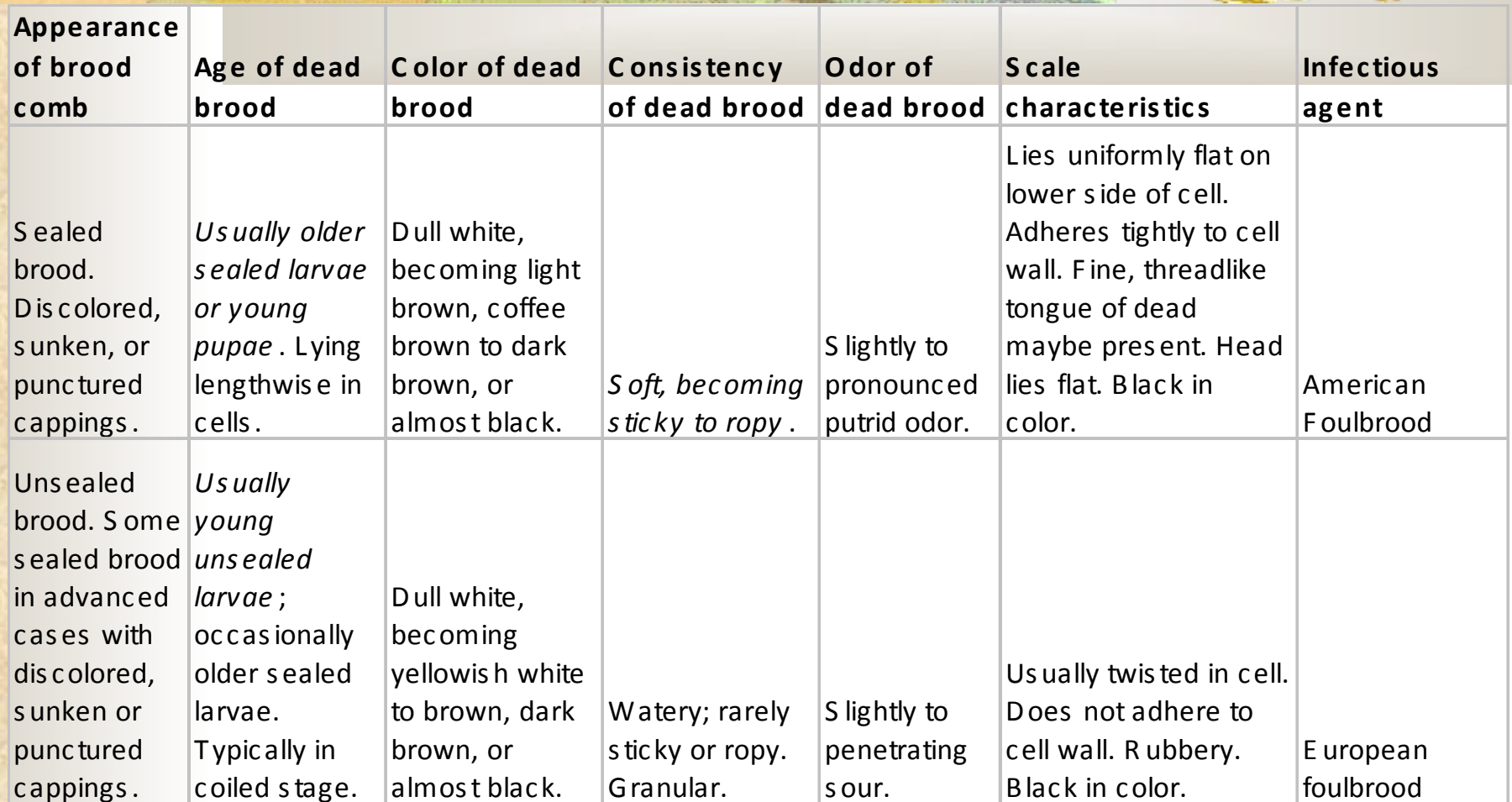


Treatment of American Foulbrood

- Antibiotics can prevent spores from germinating into the vegetative form.
They Do Not Cure sick larvae.
- Spores remain present, but healthy young larvae can develop normally.
- When treatment stops, spores germinate.
- Terramycin (oxytetracycline hydrochloride, OTC) has been used effectively
Careless prophylactic use has led to OTC resistant strains of OFB
- Tylan (Tylosin tartrate) was approved in 2005 for *treatment of known cases* of AFB. In NYS, known cases Must be destroyed; the apiary can be treated.
- Either antibiotic is applied early spring and late fall, usually mixed with powdered sugar and sprinkled over the frames 3 times, one week apart.
Treatment must be completed 4 weeks prior to honey flow.

Take-away messages-

- Hygiene- your task as beekeeper, and hopefully your bees also.
- Prevent contamination
- Early identification and destruction of diseased brood
- Regular replacement of brood comb to reduce build-up of spores or other toxins
- Record keeping- critically important for tracking health and history
 - On-line <https://www.beetight.com> or <https://hivetracks.com>
 - Hand written notes
 - Pictures



Appearance of brood comb	Age of dead brood	Color of dead brood	Consistency of dead brood	Odor of dead brood	Scale characteristics	Infectious agent
Sealed brood. Discolored, sunken, or punctured cappings.	<i>Usually older sealed larvae or young pupae</i> . Lying lengthwise in cells.	Dull white, becoming light brown, coffee brown to dark brown, or almost black.	<i>Soft, becoming sticky to ropy</i> .	Slightly to pronounced putrid odor.	Lies uniformly flat on lower side of cell. Adheres tightly to cell wall. Fine, threadlike tongue of dead maybe present. Head lies flat. Black in color.	American Foulbrood
Unsealed brood. Some sealed brood in advanced cases with discolored, sunken or punctured cappings.	<i>Usually young unsealed larvae</i> ; occasionally older sealed larvae. Typically in coiled stage.	Dull white, becoming yellowish white to brown, dark brown, or almost black.	Watery; rarely sticky or ropy. Granular.	Slightly to penetrating sour.	Usually twisted in cell. Does not adhere to cell wall. Rubbery. Black in color.	European foulbrood