

Heating

Body Temperature vs. Ambient Temperature

1. Honey Bee Brood develops best at 94°F body temperature.
2. The brood body temperature varies less than 1°F.
3. The brood is deformed if it fell outside of the body temperature range of 82°F – 98°F prior to hatching. Those hatched honey bees will have malformed wings, mouth parts, abnormal behavior and short lives.
4. The honey bees heat the cluster not the hive.
5. Honey bees would like to have about 1.5 cubic feet of space, or one ten frame hive body.
6. When the honey bees go into a cluster they form layers.
 - a. Outer layer – brings the ambient temperature up 45°F
 - b. Second layer – raises the ambient temperature from 45°F to 65°F.
 - c. Inner layer – brings the ambient temperature up to 95°F if they have brood.
7. Honey bees warm the brood two ways.
 - a. Lie on top of a cool spot, dislocate their wings and flex their wing muscles and generate about 104°F body heat.
 - b. There are heater holes located in the brood area. The worker bees go down into the hole, dislocate their wings and flex their wing muscles and generate about 104°F body heat.
8. Honey bees begin to cluster when the temperature inside the hive drops below 64°F.
9. Should there be no brood the temperature at the center of the cluster drops to 64°F body temperature. The outer edge drops to 50°F body temperature.
10. The outer edge will remain at this temperature for about twelve hours. The warmer honey bees will drag the colder honey bees into the center.
11. If the body temperature of the honey bee drops below 64°F they can't fly.

Internal Temperatures in a Honey Bee Hive

12. If the honey bee body is chilled to less than 50°F they become immobile. They enter into a chill coma. If not warmed within forty-eight hours they will die.
13. If the ambient temperature of the cluster drops to 14°F the honey bees become immobile and enter the chill coma.
14. If the honey bee cluster is formed at 64°F ambient temperature and the cluster temperature drops to 14°F the cluster shrinks 5 times the original size.
15. How much honey is needed to keep the honey bee cluster alive?
 - a. 2.2 pounds of honey per week to warm the cluster.
 - b. About 44 pounds of honey is need for wintering.
 - c. It takes 110 pounds of nectar to produce 44 pounds of honey.
16. Once the cluster is formed and the body temperature is about 64°F the cluster will not split.
17. In search of honey the cluster will move vertically.
18. The honey bees are only interested in heating the cluster, and brood but not the hive.

Cooling

1. The brood will die if the body temperature exceeds 96°F.
2. Beeswax comb will start to get soft and collapse when 104°F ambient temperature is exceeded.
3. Adult honey bees will die if the ambient temperature is greater than 113°F.
4. It has been tested that a hive temperature of 95°F to 97°F can be maintained if the ambient temperature is 140°F.
5. The honey bees will start to ventilate the hive when the inside temperature starts to exceed 97°F.
6. If fanning fails to reduce the temperature then the honey bee will use evaporation by placing water on the surface of the brood.
7. Another way the honey bees reduce inside temperatures is to go outside. This is called bearding.

Internal Temperatures in a Honey Bee Hive

Sources

1. USDA study 1952, Madison, Wisconsin, what happens in the hive during the winter.
2. The Buzz about Bees, Biology of a Superorganism by Dr. Jurgen Tautz,
3. Colony level thermoregulation by Dr. Jamie Ellis