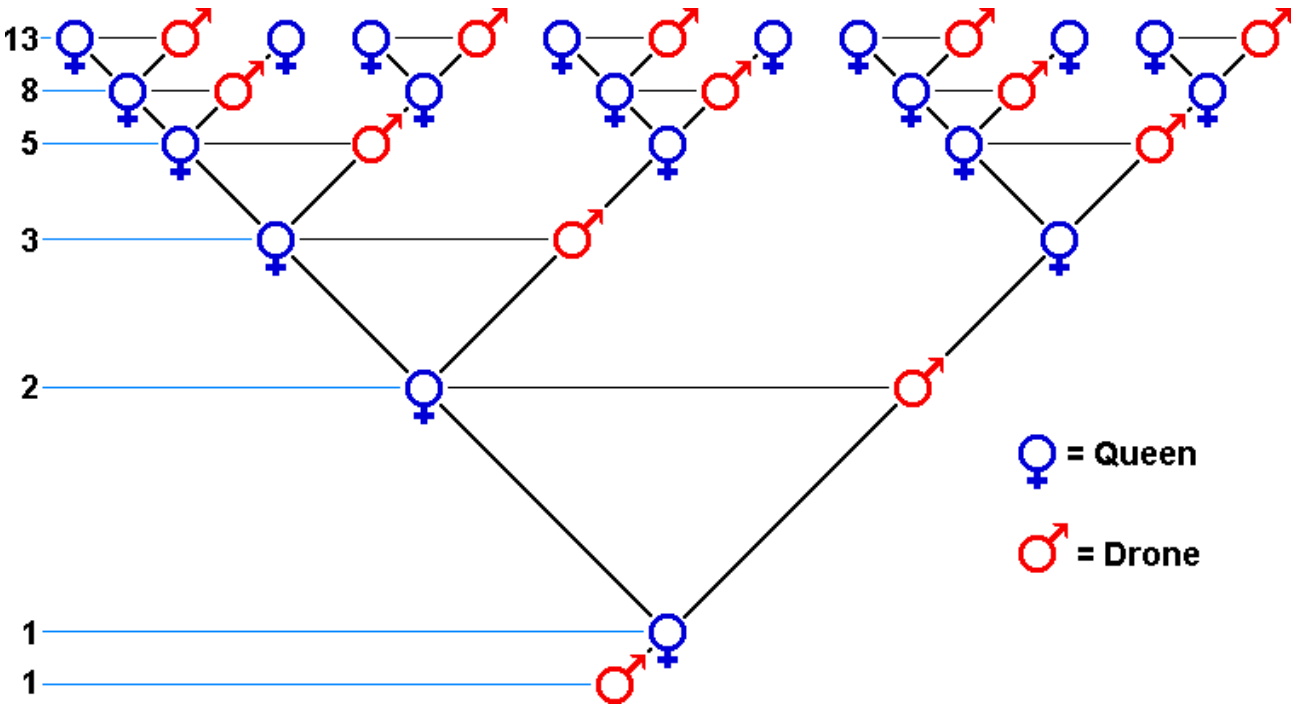
Bees and Fibonacci sequence

Fibonacci sequence

The Italian mathematician Leonardo da Pisa (1170 – 1250), alias Fibonacci, found out a sequence or series of numbers which is related to many features in biology and other branches of science. In this recursive sequence each number is the sum of the two previous numbers. Thus, the sequence begins 1, 1, 2, 3, 5, 8, … that is 1+1=2, then 1+2=3, then 2+3=5 etc., as follows: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181… and so on forever.
Dividing two consecutive numbers, for example 34 by 21 or 233 by 144 you will see that the ratios approach the decimal 1.61803 (symbolised by the Greek letter Φ) to five places. Over and over in nature, in both living and non-living realms, this particular number comes up again and again, representing beauty, harmony, perfection. Known as the Golden Ratio, Divine Proportion, Golden Mean, Golden Section, etc. because of its frequency in the natural world, it can be observed in branching systems, flowers and seeds, as well as in the spiral arrangement of plant and animal organs.

Bees

But what is its link with bees?
Bees have interesting family trees. In every beehive there is one female queen bee who lays all the eggs. If an egg is not fertilised it eventually hatches into a male bee, called a drone. If an egg is fertilised by a male bee, then the egg produces a female worker bee, who doesn't lay any eggs herself (unless she is fed royal jelly, in which case she will turn into a queen to challenge the existing one or fly off and start a new hive).
Therefore, a drone only has one parent (a mother and no father), who is a queen, and only 2 grandparents. A queen has two parents, a queen and a drone.
When Fibonacci was asked why he studied these numbers and their ratio he replied: "Someday these numbers will unlock the secret of nature and will explain why a drone does not have a father". Actually, the pattern of growth in some mysterious way matches the forces controlling growth in a large variety of natural dynamical systems.
The Fibonacci sequence is a great representation of the bees' reproductive pattern. From the ancestry tree below you can calculate how many parents, grandparents and great grandparents a male or a female bee would have etc.



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If you divide the number of female bees in any beehive by the number of male bees, you get the same number (Φ). Here again the pattern is not random: it is following mathematical rules reflecting some geometry intimately related to the golden ratio, which is likely to reveal the effect of an inherent law of the Cosmos in the honeybees' world.



1 **Read the text and find the words corresponding to the following definitions.**

1. A chart showing the relationships between the different members of a family: .....
2. To disclose: .....
3. Principle, rule: .....
4. Without definite aim, rule or method: .....
5. To become, to be transformed into: .....
6. A structure in which bees are kept: .....
7. To bring forth, deposit: .....
8. Relationship, connection: .....
9. Finally: .....
10. Layout: .....
11. An important part or characteristic: .....
12. A field of study: .....
13. Kingdom: .....
14. Relating to a procedure that can repeat itself indefinitely: .....
15. Following one another in succession: .....
16. Proportion: .....

The Fibonacci Sequence

1,1,2,3,5,8,13,21,34,55,89,144,233,377…

1+1=2	13+21=34
1+2=3	21+34=55
2+3=5	34+55=89
3+5=8	55+89=144
5+8=13	89+144=233
8+13=21	144+233=377

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2 **Read the text and decide if the statements are true or false. Then identify the most logical words in the text which may support your decision, writing them in the box. The first one is an example.**

1. All the numbers in Fibonacci sequence are multiple of three.

F	*Each number is the sum of the two previous numbers.*

2. Fibonacci numbers appear in nature quite often.

3. All female bees lay all the eggs.

4. A drone is the result of a fertilised egg.

5. Honeybee larvae develop into queen bees if they are fed royal jelly.

6. There is a relationship between Fibonacci sequence and the bees' reproductive pattern.

7. Φ is the ratio between number of female bees and the number of drones.

8. The mathematical justification of this reproductive pattern seems to prove that the universe is based on the chaos.

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