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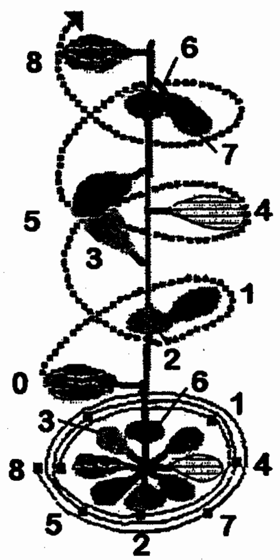
FIBONACCI NUMBERS

About 600 years ago a mathematician by the name of Leonardo Fibonacci (later known as Leonardo Pisano) was given a problem by a member of the Italian royal family that went something like this: *"Suppose a newly born pair of rabbits (one male and one female) is put in a place surrounded on all sides by a wall. These rabbits take a month to become adults, after which time they give birth to a new pair of baby rabbits (again, one male and one female). If every month each pair had a new pair, how many pairs of rabbits will there be in one year?"*

Leonardo wrote down the number of rabbits at the end of each month, and came up with the following pattern of numbers: **0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377,** and so on.

What is really neat about those numbers is that every number in the pattern is the sum of the two that came before it: 0+1= **1,** 1+1= **2,** 1+2= **3,** 2+3= **5,** 3+5= **8,** 5+8= **13,** 8+13= **21,** and so on. Leonardo stumbled upon a very important mathematical discovery, known as the Fibonacci sequence, or **Fibonacci numbers**. Even though it was first used to count rabbits, we see the Fibonacci sequence showing up over, and over, in nature.

For example, Fibonacci numbers are almost always found in the placement of leaves around a plant's stem (*phyllotaxis*). Leaves do not grow where they do by chance and accident. There is a pattern. They may be placed one after the other, opposite, circular, or in a spiral. Look at the picture of the King Sugarbush. Starting at leaf 0 and counting spirally, we see that it takes exactly **3** turns to find a leaf in the same place over leaf 0. There are also **8** leaves within those turns. Hmmm…two Fibonacci numbers! Many other plants also show these numbers (*see chart on back*).



King Sugarbush

These patterns make sure that each leaf will receive as much sunlight and air as possible without shading or crowding other leaves.

We also find this arrangement in many flower petals. Just some example, an Enchanter's Nightshade has **2** petals, and a Lily has **3**. A Yellow Violet has **5** petals, the Delphinium **8,** and the Mayweed **13.** Asters have **21** petals, Pyrethrum **34,** and **55** on some Helenium. A whopping **89** petals came be found on some Daisies and Michaelmas flowers. Hmmm…more Fibonacci numbers! Here are some more:

The DNA molecule is **21** angstroms wide and the length of one full turn in its spiral is **34** angstroms ...both Fibonacci numbers!

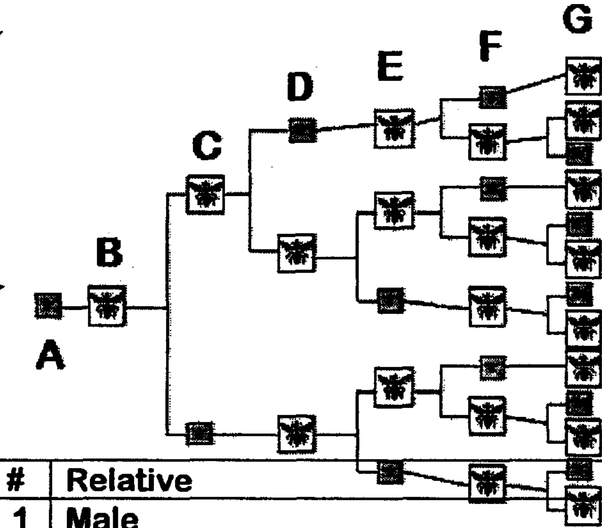
If you compare in round numbers the time it takes each planet to go around the sun with the time of the planet next to it, their fractions are Fibonacci numbers! Beginning with Neptune and moving inward toward the sun, the ratios are **1/2, 1/3, 2/5, 3/8, 5/13, 8/21, 13/34**. These are the same as the spiral arrangement of leaves on plants (*see chart on back*)!

If you look at a pinecone or a sunflower, you will find there are spirals running in two directions. However, the number of spirals running in each direction is not equal. You might have **8** spirals running in one direction, and **13** running in the other ... but the numbers are always **neighbors** in the Fibonacci sequence.

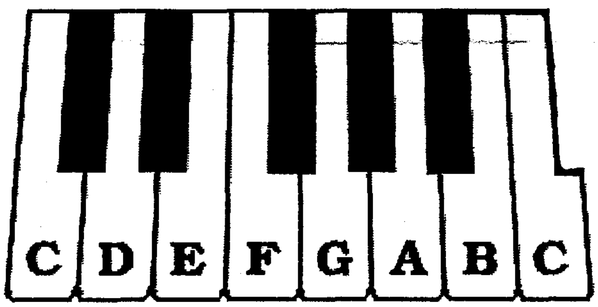
If you divide one Fibonacci number into the one before it you get a number called the **"Golden Ratio"**. It is a special number that shows up over, and over, and over throughout the universe (*more about it in the next Kids Think and Believe Too*).

Fibonacci numbers and golden ratios are just one more example of incredible design found in nature - design that could never have happened by the chance and accident of evolution. I believe that when we take a good look at the evidence, it is clear that it is "God that made the world and all things therein," (Acts 17:24a). Only the hand of God could create such marvelous wonders that we find around us!

Phyllotaxis of different Plants *T* is number of turns on stem. *L* is number of leaves within turn(s) [shown as fraction *T / L*]	
PLANTS	**T / L**
Basswood, Elm, & many bulbous plants	1 / 2
Hazel, Beech, Sedge, Alder, & Birch	1 / 3
Apricot, Cherry, Willow, Oak, Rose, & Stone-fruit	2 / 5
Pear, Poplar, Cabbage, Aster, & Hawkweed	3 / 8
Almond & Pussy Willow	5 / 13
Spruce & Fir Cones	8 / 21
some Pines	13 / 34



	#	Relative
A	1	Male
B		Mother
C		Grand parents
D		Great-grandparents
E		Great-great-grandparents
F		Great-great-great grandparents
G		Great-great-great-great grandparents

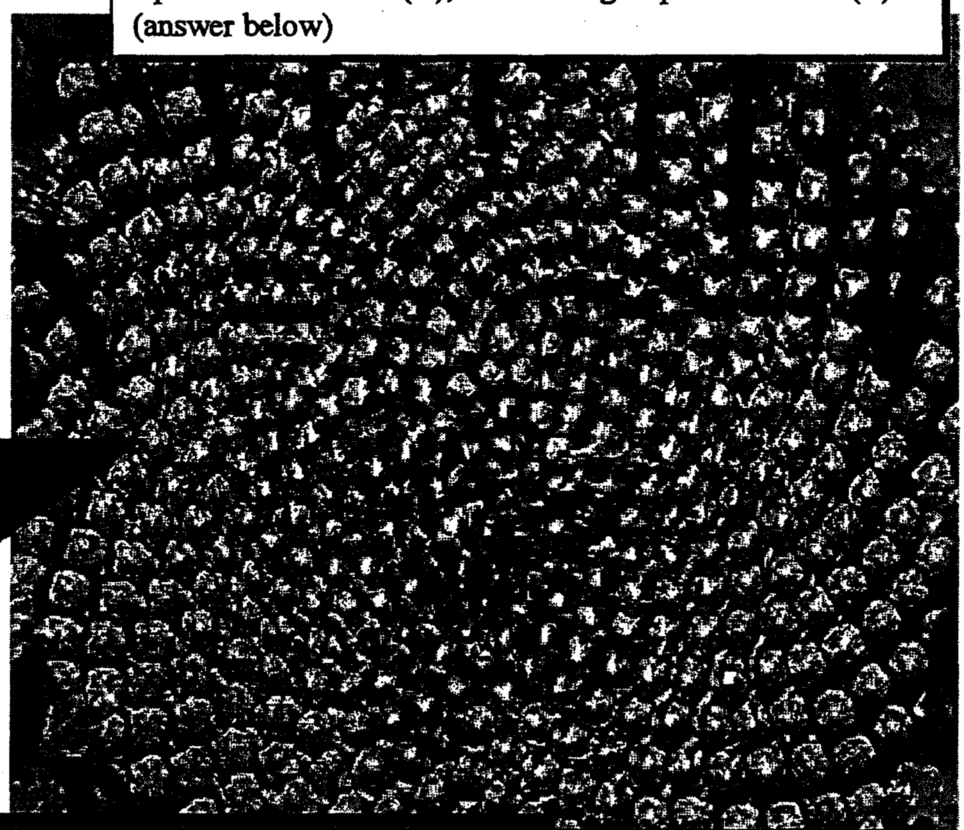


YOU DO THE MATH

A male bee only has one parent ... the female queen. However, it takes a male and a female to make a female. Look at the picture above and using the chart, count how many parents and grandparents a male bee has. What kind of numbers did you come up with? *Note: the small shaded square is a male bee (A), and the large square a female (B). (answer below)

Looking at the piano keyboard above, how many **complete** keys do you count? ____ How many white keys? ____ How many black keys? ____ The black keys come in two groups. How many in each group? ____ & ____. Notice something about the numbers?

Looking at the sunflower on right, carefully count the number of spirals turning to the left. ____ How many do you count turning to the right? ____ Notice something about the numbers?



ANSWERS

Bees: B-1 C-2 D-3 E-5 F-8 G-13.
Keyboard: 13 total, 8 white, 5 black, group of 2 & 3.
Sunflower: 34 to left, 21 to right.

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