Fibonacci Number Sequence and Wild Flowers

Grade level: 4th – 6th
Performance and Content Standards: Math A2, 3, 4, and 5. Science: 12, 14; B1, 2.

Information: Patterns come in different forms. They can be number, geometry, size, shape, or symmetry. Fibonacci number patterns can be observed in many things in nature. On many flowers, the number of petals is a Fibonacci number. For instance: buttercups, wild rose, and larkspur have 5 petals; lilies and iris have 3 petals. Also many plants show the Fibonacci numbers in the arrangements of the leaves around their stems. A Fibonacci ratio consists of any Fibonacci number divided by another Fibonacci number. Ex 5/8, 8/13, 2/3, etc.

Concept: Students will be able to explain what Fibonacci numbers are, and determine what percentage of wildflowers in their area have Fibonacci numbers.

Material: A small bag of Candy bears for each student to use with the activity in "Explore."
Trudi Hammel Garland's Fascinating Fibonaccis, Mystery and Magic in Numbers, published by Dale Seymour Publications.

Gear Up:
(This activity is a modified version of Dudeney's Cows. Henry E. Dudeney (1857 – 1930) adapted Fibonacci's investigation of rabbits (in 1202) to cows, making the problem more realistic. Since there are not many cows in Alaska, I have modified it to bears.)

Post of the following question on the board:

"If a female bear produces its first she-bear-cub at age two years and after that produces another single she-bear-cub every year, and the she-bear cubs start to produce a single she-bear cub two years later and for every year after. How many she-bears are there after 5 years? 6 years? 7th? Assuming none dies, and every female bear only gives birth to one single female cub every year at age two years and every year after."

Explore:

Give students a bag of Candy bears to manipulate and ask them through with the following questions:

1. At the end of the first year, how many female bear? (One)
2. At the end of the second year, the female bear produced a she-bear-cub, so now how many female bears? (Two)
3. At the end of the third year, the original female bear produces a second she-bear cub, but the young cub bear is not old enough to produce any baby yet, how many bears now? (Three)
4. At the end of the fourth year, the original female has produced yet another she-bear-cub, and the she-bear-cub born two years ago produces her first she-bear-cub also, so how many bears do you have now? (Five)
5. Let's find out how many bears at the end of the fifth yea, the sixth, and seventh.

Have students put up their findings on the board.

Generalize:
Why did these patterns occur? Where else can we find patterns**:**

Explore #2:
Write the following number sequence on the board, and ask student to predict what the next three numbers are. "1, 1, 2, 3, 5, 8, 13, 21, ___, ___, ___…" Ask students if they can see how the pattern is formed and have them continued it..

Generalize:
Explain to students that this number sequence is known as Fibonacci number sequence. Inform students that Fibonacci was a brilliant Italian mathematician who lived about 800 years ago. His real name was Leonardo of Pisa. He used "Fibonacci" for writing purpose. He wrote a book called Liber Abaci , in English it meant "Book of the

Abacus" or "Book of Calculating". One well-known problem involved speculating on what would happen if a pair of rabbits were put into a walled enclosure to breed: His origin problem was something like this:

> "How many pairs of rabbits will there be after a year if it is assumed that every month each pair produces one new pair, which begins to bear young two months after its own birth?"

The following table is the tally of the pairs of rabbits by month. (From Trudi Hammel Garland's Fascinating Fibonaccis, Dale Seymour Publications, pp 4.)

Month	No. of Pairs of Babies	No. of Pairs of Adults	Total No. of Pairs
Jan. 1	0	1	1
Feb. 1	1	1	2
Mar. 1	1	2	3
Apr. 1	2	3	5
May 1	3	5	8
Jun. 1	5	8	13
Jul. 1	8	13	21
Aug. 1	13	21	34
Sep. 1	21	34	55
Oct. 1	34	55	89
Nov. 1	55	89	144
Dec. 1	89	144	233
Jan. 1	144	233	377

Tell students that the rabbit/bear problem and its solution are unnatural, rabbits and bears really don't breed quite that way, however, the Fibonacci number pattern can be observed in many things in nature.

Explore #3:
Can you find Fibonacci numbers in vegetables and fruit? Try to count how many "flat" surfaces a banana has. Is it 3 or 5? If you cut the banana in half, do you see a Fibonacci number inside? If you cut the apple along the "equator", what do you find? Look at a head of cauliflower. See what you can find out about a head of cauliflower. Notice its florets rotation. Pineapple provides a good example of Fibonacci numbers.

Generalize:
Sometimes four different Fibonacci spirals (parallel scales on the outer skin) can be identified on one pineapple. Studies have shown that there is high percentage likelihood that the numbers of spirals on any pinecone will be numbers from the Fibonacci sequence. However, you might find that it is hard to count the numbers on the pinecones or sunflower seeds.
You can find more information about this from Trudi Hammel Garland's Fascinating Fibonaccis, Mystery and Magic in Numbers, published by Dale Seymour Publications.

Experiment:
The growth patterns of plants usually are Fibonacci number. On many flowers, the number of petals is a Fibonacci number. For instance: buttercup, wild rose, and larkspur have 5 petals; lilies and iris have 3 petals. Also many plants show the Fibonacci numbers in the arrangements of the leaves around their stems. The ratio of leaves and the rotation on the stem are Fibonacci numbers.

Post the following testable question to students: "Do all the flowers we find around our schoolyard have Fibonacci numbers? If not, what percent of flowers possess Fibonacci numbers?"

Have students pick as many different kinds of flowers around the schoolyard as they can. Pick the flower as close to ground as possible, so they can observe the stem/leave rotation on a plant.

- Use resource books to identify the flowers.
- Sort the flowers by the number of petals.
- Record the finding on the worksheet.
- Observe the stem rotation. Note the number of the stems/leaves produced in relationship to the number of turns. Record these observations.

The following worksheet can be used to record the findings. ** Stems/leaves Rotation Ratio can be determined by finding a stem/leave directly above another stem/leave and counting the number of full circle turns the branch went through while generating the stems in between as well as the newest stem. (The original stem is not counted.)

Name of the flower	Number of petals	Fibonacci Number Yes/No	**Stem/Leave Rotation Ratio	Fibonacci Ratio Yes/No
Total Number plants with Fibonacci numbers				
Percentage of plants with Fibonacci numbers				

Interpret: Students display and interpret the data that they have collected. How many flowers did they collect? Do all the flowers that they collect bear Fibonacci numbers? If not, what percentages are Fibonacci numbers? Make a bar graph to show the data.

Apply:
Look at your own hand: You have two hands, each hand has 5 fingers, and each finger has 3 parts that are separated by 2 knuckles, are they Fibonacci fingers?

Look around your surrounding. Can you find other things in your environment that have a Fibonacci sequence? Fibonacci numbers live on!

Assessment:

Students will:

(A) Collect at least ten wild flowers and correctly identify them.
(B) Sort the flowers by the number of petals and record the findings on the record sheet.
(C) Find the percentage of the wild flowers that have Fibonacci number sequences.

Scoring Guide: **Assessment Rubric**

Outstanding	3 points	Student collected at least ten wildflowers to observe. All the wildflowers were identified correctly. All data was put into a neat table format. Percentage was calculated accurately.
Competent	2 points	Student collected less than 10 wildflowers. Not all flowers were identified correctly. There are minor mistakes in calculations. Work is done completely, but not neatly.
Fair	1 points	Student showed effort in collecting flowers. Flowers were not identified. Data was put into the record sheet incompletely. No percentage was calculated.
Poor	0 points	Student did little or none of the assignment.