LIVING STEM

AGE : 12 - 14

The Fibonacci sequence in Nature

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Activity n°1

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Educator's guide

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Introduction

Two of the fundamental elements of permaculture design are “Observation”, the very first action taken once the design objective is defined; and the significance of “patterns”. Observing patterns in nature is primordial in the design methodology.

The Fibonacci series or sequence is a very interesting mathematical reality that often eases up students to their preconceived notions of math being difficult or boring. Not usually included in the curriculum in Geometry lesson plan for 10-14 years old, the prevalence of Fibonacci numbers in nature helps in making younger students understand them, help them observe the patterns in the natural world, and cultivate a more enticing view of mathematics.

Calendar

The research, field trips and challenges can be carried out all year round. To achieve a more effective usage, spring and summer months (the months depend on the country) are best months to implement this activity.

Duration

Classroom learning: 1,5 hours
Task 1: 1 hour
Task 2: 1 hour
Filed trip: 1 hour
Post field trip classroom learning: 1,5 hours

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Important note

In Belgium and possibly in other European countries, the Fibonacci series is introduced only to students following advanced Geometry classes therefore not for ages below 16 years. However, in other countries like the USA and India, the Fibonacci concept is introduced to as early as 10 year-old students classified as “gifted and talented students”. The advantage of using Fibonacci to fascinate students with mathematics at young age can help augment the interest of the students to this discipline.

Gamification method(s)/technique(s)

The fun aspect of this activity lies in the challenges the students will face. Visually tracing the Fibonacci sequence in fruits, flowers and vegetables will be an enjoyable exercise. The group challenges posted during field trips also add up to the excitement. Illustrating the Fibonacci series through drawings is a relieving activity to the artistically inclined and a fun challenge to the students who are not.

Preparation

The educator needs to have proper knowledge of the Fibonacci numbers. S/he should have in-depth and conscientious background of permaculture to be able to interconnect with ease the mathematics in nature as espoused by the Fibonacci series and the golden ratio.

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Tasks and Challenges

1. In-Class learning:
Two hours of class lessons on the Introduction to Fibonacci and the Fibonacci series are a prerequisite. (See Annex 1 for an overview).

1.1. Individual work:
Task 1: Every student is tasked to observe the plants and flowers in their garden or their neighbourhood. Take photos and journal at least 5 natural things where the Fibonacci series is and explain briefly what is observed (which part of the plant is it visible, how, etc.)

Task 2: Research the name of the plants or flowers in task 1 as it is commonly known in the local language, the latin name and its origin. There are free apps that can help students with this task, otherwise use internet research or interview a local horticulturist.

2. Field Trip
1. Group the students in 3's or 5's depending on the size of the class.

2. Prior to heading into the forest or park, make sure to explain the rules of no picking or plucking flowers. The importance of keeping it as is when they leave the area.

3. Explain that the task is to identify as many things in nature that demonstrates the Fibonacci series and be able to explain the series. Each time a group finds the Fibonacci number in nature, they have to call out "Fibonacci" and present briefly their finding to everyone. They have to add this in their journal if not yet previously logged in. Each group has to find a different specie from what has already been found by other groups. Repeating the specie found from their individual task during this field trip is possible as long as the specie has not been presented by other groups yet.

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Tasks and Challenges

4. Before heading into the forest or to the park, ask the students to collect or pick up 5 pieces of any quantifiable natural materials they can carry with them (pebbles, twigs, dry leaves, small branches). With careful observation, a student's choice of materials can offer a hint on their personalities and attitudes; information useful to a good educator in approach personalization. Curious students will insist to know the purpose of the 5 pieces. The educator tells them that they will find out along the way. (lesson of patience).

5. Once the first group identifies the Fibonacci number, explain the purpose of the gathered materials: that each time their group shares their Fibonacci finding, they can exchange with the educator the pebble with a seed.

6. Towards the end of the game, the troupe stops and they determine the winning group/s who identified the most number of Fibonacci series during the walk. The use of the seeds can be related to Gamification activity on Permaculture and Biology or independently. The purpose of the seeds is to continue their observation of the Fibonacci series as they plant, grow the seeds.

7. Explain the philosophy in this reward system: "being a winner entails responsibilities". (fun part: relate this to Spiderman's lesson: "With great power comes great responsibilities." Why seeds? It is because seeds are priceless: all the food we eat, all the trees we see, all products or projects we realize, all start from seed.

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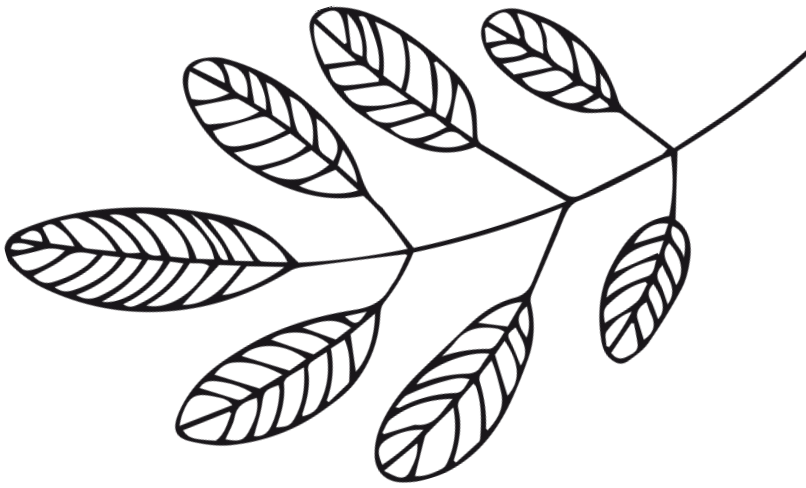
Tasks and Challenges

8. Explain the relevance of the experience with permaculture principle. The educator may cite one or two examples depending on the time available. (Annex 3: Pedagogic Aid-Permaculture and Fibonacci).

3. Post-field trip In-class lesson:
One hour lesson to deepen the understanding of the impact of the Fibonacci series in the biological process of the species. An example is presented in Pedagogic Aid Annex 3 (sunflower and thistles) and further research from the educator will be useful.

3.1. Encourage the students to present their own observations, theories and analysis based on their findings from previous tasks on how they think the Fibonacci series impacts the life and survival of their observed species. Allow homework research if needed.



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Debriefing outcomes & obtained competences:

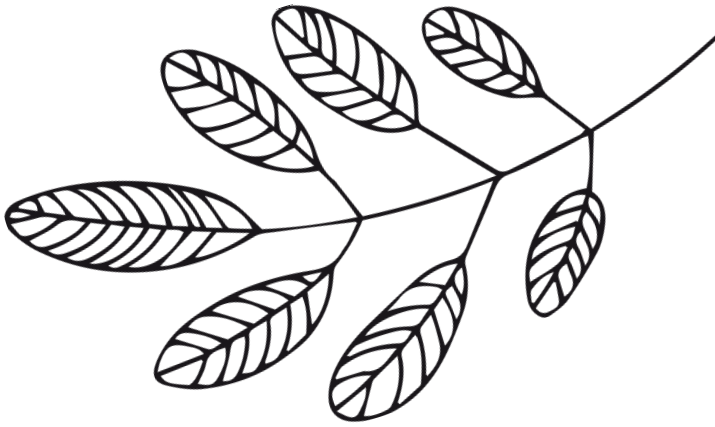
STE(A)M Learning objectives:
At the end of this activity, the students should be able to:

1. Understand Fibonacci numbers and their origin.
2. Identify Fibonacci numbers in nature and the world around us.
3. Generate the next numbers in the Fibonacci sequence.
4. Comprehension in the function of the series in the biological existence of a specie
5. Determine why patterns in nature are relevant to permaculture design

Methods applied:
Field observation with analysis, documentation and presentation.

Related STE(A)M theory:

- Mathematics: Geometry
- Science: Biology



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Developped skills

- Balanced development of research skills and creative problem solving
- Sensitivity and responsibility to others
- Self-expression

Necessary Equipment and Materials:

- Educator: Seeds for the reward
- Students: Notebook and pen

Key words

Permaculture, Permaculture design, patterns in permaculture, patterns in nature, Fibonacci sequence/series/numbers, Fibonacci in nature, Mathematics in nature

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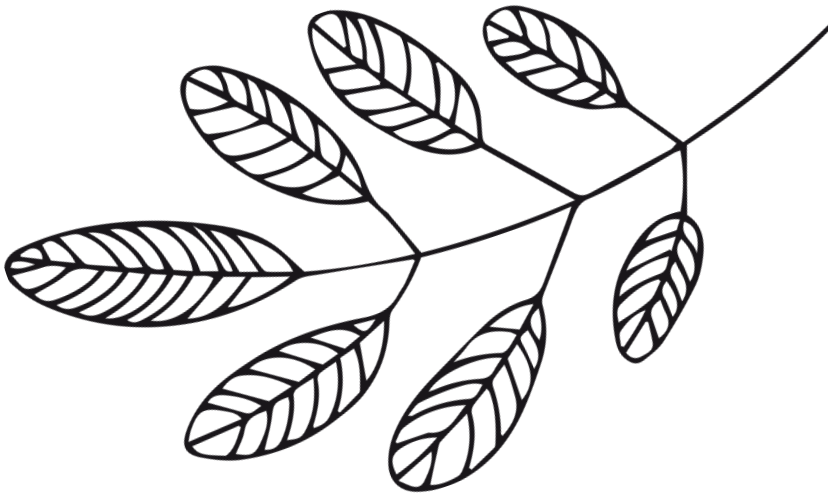
Media and Resources

1. Internet access
2. App to identify and research on plants
3. Camera through phone, tablet or using a real camera
4. Internet resource:

https://www.mensaforkids.org/teach/lesson-plans/fabulous-fibonacci/



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