

Title	Exploring Pine Cone Fractals Using Computational Thinking	Time	3 hours
Subject:		English Language, Art, Mathematics and Nature Studies	
Aims		General competence¹: Awareness of computational thinking concepts to create pine cone fractals. Specific competence²: Allowing students to deepen their understanding of the fractals and computational concepts. Aim of the activity: How to make pine cone fractals using computational thinking	
Key CS elements:		Decomposition; Pattern recognition; Abstraction; Algorithm design.	
Age group :		10-12 year old	
Learning place:	Çetin Şen Science and Art Center	Activity type:	extracurricular
Resources:			
<ol style="list-style-type: none"> 1. Websites or apps about Math and Nature activities. 2. Computer/ mobile phones with internet access. 			
Learning development:			
Problem definition: Creating the right steps to make pine cone fractals by using computational thinking skills and natural materials.			
Introduction <ul style="list-style-type: none"> -Start by showing students a pine cone and ask them if they notice any patterns in its structure. -Explain that the patterns they see are examples of fractals, a concept found in nature, art, and even computer science. -Introduce the lesson's goal: to explore the patterns in pine cones using computational thinking skills. 			

Four Principles of Computational Thinking:

1. **Decomposition:** Breaking down complex steps into smaller, manageable parts.
2. **Pattern Recognition:** Identifying similarities or patterns within data.
3. **Abstraction:** Focusing on essential details while ignoring unnecessary information
4. **Algorithm Design:** Creating a step-by-step plan for creating pine cone fractals.

I. Decomposition:

1. **Observation:** Hand out pine cones to each student.

Ask them to observe the pine cone closely with magnifying glasses, focusing on the scales' arrangement.

2. **Break Down the Problem:** Guide students to break down the complex structure of the pine cone into simpler parts:
 - Identify how the scales are arranged in spirals.
 - Count the number of spirals in each direction (left and right).
 - Record their observations on graph paper.

Task: Ask students to decompose the structure of the pine cone. What shapes do they see? Can they count how many spirals exist in each direction? Encourage them to examine closely and take notes.

II. Pattern Recognition

1. **Finding Patterns:** Ask students to compare the number of spirals in each direction. Help them recognize that these numbers often follow the Fibonacci sequence.
2. **Drawing:** Have students use colored pencils to draw the spirals on graph paper, labeling the numbers of spirals in each direction.
3. **Discussion:** Discuss how these patterns repeat in nature and are examples of fractals.

Task: Ask students if they can find a repeating pattern in the pinecone's spirals. Point out how the same pattern repeats as the pinecone grows.

III. Abstraction

1. **Simplify the Concept:** Introduce the idea that fractals are patterns that repeat at different scales.
2. **Relate to Nature:** Show examples of other natural fractals (like tree branches, rivers, and lightning) using the handouts or digital devices.
3. **Group Activity:** Have students discuss in small groups how the pine cone's structure can be seen as a simple model for understanding more complex natural fractals.

Task: Ask students to abstract the pine cone's shape into simpler forms. Can they draw the basic spiral patterns they see without adding extra details?

Algorithm design:

- **Explain:** Algorithm design involves creating step-by-step instructions to solve a problem.
- **Task:** Guide students to develop an algorithm for recreating the pine cone’s spiral pattern using natural materials.

Step 1: Choose materials that can represent the scales (e.g., small leaves or stones).

Step 2: Draw a spiral on paper or the ground.

Step 3: Place the materials along the spiral in a repeating pattern.

Step 4: Create multiple spirals moving outward in both directions, following the fractal pattern.

Conclusion

- 1. Reflection:** Ask students to share their fractal drawings and discuss what they found most interesting about the patterns in pine cones.
- 2. Wrap-Up:** Reinforce the idea that computational thinking helps us understand and model complex patterns found in nature, like those in pine cones.

Homework/Extension:

- **Nature Walk:** Take students on a nature walk to find other examples of fractals in the environment, such as leaves, flowers, and shells.
- **Digital Exploration:** Use a computer program or app to create digital fractals and explore how changing parameters affects the patterns.

Assessment:

- Observe student participation during discussions.
- Review the written algorithms and the final fractals for creativity and adherence to the plan.
- Evaluate students’ reflections on the CT process.

Expected results:

- Understand fractal patterns and their significance in nature.
- Be able to decompose complex natural forms and identify repeating patterns.
- Use abstraction to simplify and represent complex patterns.

- Develop an algorithm to recreate fractal structures using natural materials

Notes:



Materials:

- Pine cones (1 per student)
- Magnifying glasses
- Graph paper
- Colored pencils or markers
- Rulers
- Digital devices with internet access (optional, for additional research)
- Printed handouts with examples of fractals (e.g., snowflakes, leaves, shells)