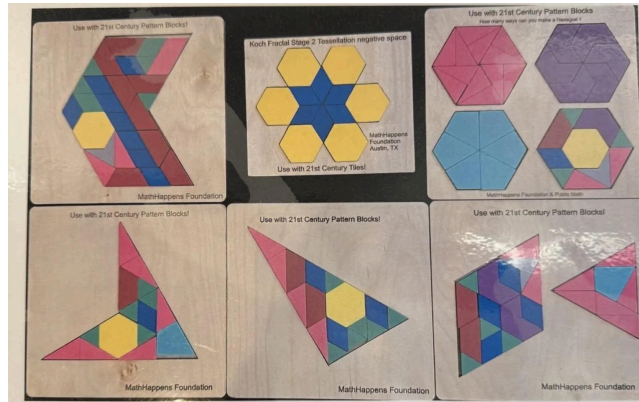




# Math Behind the Models 21st Century Pattern Blocks



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## Alignment to [NCTM Standards](#)

### Short Version:

This model supports NCTM standards by engaging learners in:

- **Geometry:** composing/decomposing shapes, symmetry, transformations.
- **Algebra:** tile substitutions model equivalence and functional relationships.
- **Fractions & Number:** part-whole reasoning through tile area comparisons.
- **Mathematical Practices:** problem solving, reasoning, communication, representation.
- **Equitable Engagement:** family participation and open-access math play.

## Number & Fraction

### **NCTM Goals Addressed:**

- Understand parts-whole relationships.
- Compare and order fractional quantities.
- Use models to represent fractions, ratios, and proportional reasoning.

### **How This Model Supports These Goals:**

- Substituting tiles to fill areas evokes fractional reasoning:
  - *“This tile covers half of that frame section.”*
  - *“Four small triangles cover the same space as one chevron.”*
- The block-to-block comparisons promote conceptual rather than procedural fraction learning.

## Geometry

### **NCTM Goals Addressed:**

- Analyze characteristics and properties of shapes.
- Explore transformations (slides, flips, turns).
- Compose and decompose shapes.
- Recognize and apply geometric patterns.

### **How This Model Supports These Goals:**

- The frames (hexagon, heart, Koch fractal stages, animals) encourage spatial reasoning and geometric assembly, requiring learners to rotate, reflect, and translate tiles to complete designs.
- Because the tile shapes can all be constructed from the Seed of Life geometric structure, the activity naturally supports discussions of symmetry, tiling, and structure.
- Free-play building encourages children to generalize geometric properties and observe how shapes compose into complex forms.

## Algebraic Thinking

### **NCTM Goals Addressed:**

- Understand patterns, relations, and functions.
- Use representations to model mathematical relationships.
- Develop an early sense of equations and reasoning about equivalence.

### How This Model Supports These Goals:

- The tiles offer substitution relationships, such as:
  - *Two triangles equal one diamond,*
  - *Two diamonds equal one chevron.*
    - These mirror algebraic equivalence ( $A = B$ ,  $2B = C$ ).
- Learners naturally engage in if-then reasoning, making the blocks an accessible representation of algebraic structure.
- The system encourages students to generalize relationships, laying the groundwork for functional thinking.

## Mathematical Practices

### NCTM Practices Supported:

- **Problem Solving:** completing frames, creating patterns, designing unique tilings.
- **Reasoning & Proof:** making claims about tile equivalences (e.g., why two shapes are the same area).
- **Communication:** discussing strategies with facilitators or peers.
- **Connections:** relating geometry to algebra through substitution, and to art through framed patterns.
- **Representation:** using concrete manipulatives to model abstract ideas.

### How This Model Supports These Practices:

- The open-ended nature ensures multiple entry points and solutions, ideal for mathematical inquiry.
- Visitors often verbalize or justify their designs, supporting math talk and mathematical argumentation.
- The blocks' unusual shapes (unlike standard pattern blocks) broaden mathematical imagination and representation.

## Identity and Family Engagement

The activity encourages positive parent/family interactions and shared mathematical play, which aligns with NCTM's calls for equitable learning experiences that promote identity, belonging, and visibility in mathematics.

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