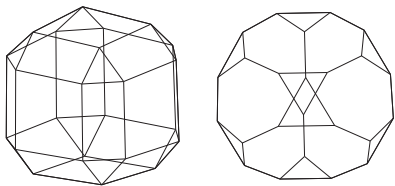


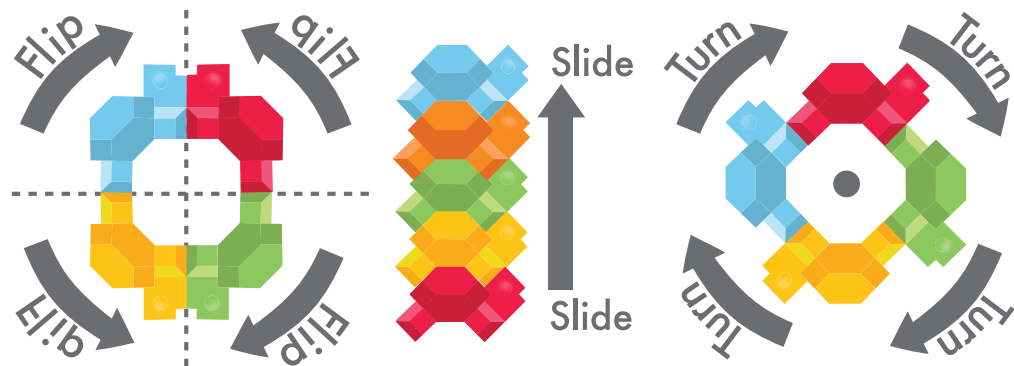
Fat Brain Toy Co.  
Elkhorn, NE 68022  
800.335.5621  
[www.fatbraintoyco.com](http://www.fatbraintoyco.com)  
Please keep all relevant information.  
Made in China



# REPTANGLES™

## EXPLORATION GUIDE

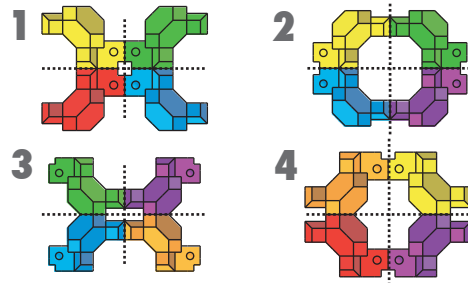
Table of Contents	
Information	pages 1-2
Basic Structures and Symmetries	pages 3-5
Building Polyhedra	pages 6-10
Creative Exploration Activities	pages 11-14
Pattern Puzzles	pages 15-16
Expert Puzzles	pages 17-18



## BASIC STRUCTURES

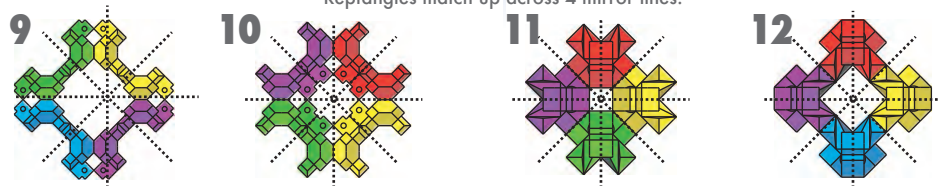
### 2-Fold Mirror Symmetries

Reptangles match up across 2 mirror lines.



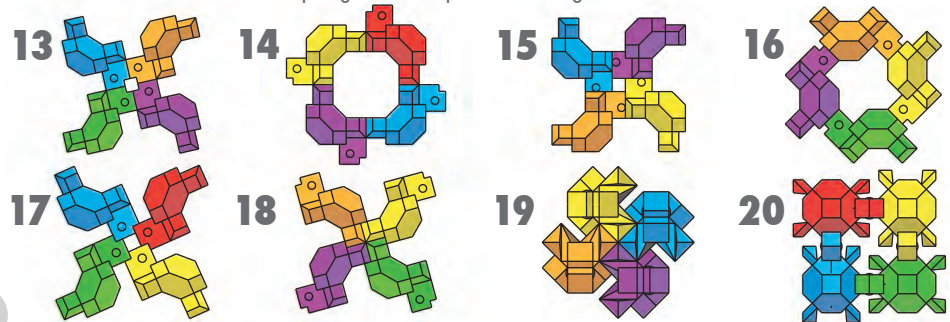
### 4-Fold Mirror Symmetries

Reptangles match up across 4 mirror lines.



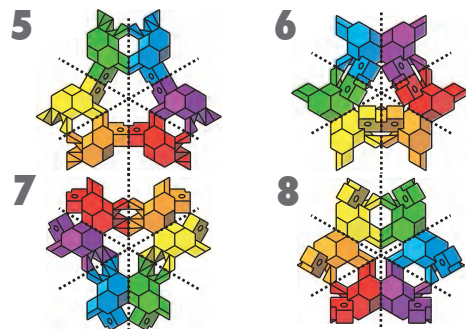
### 4th Order Rotational Symmetries

Reptangles match up 4 times during one 360° rotation.



### 3-Fold Mirror Symmetries

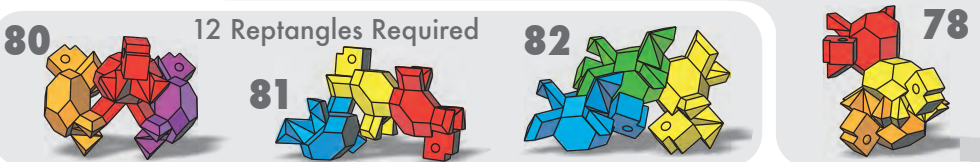
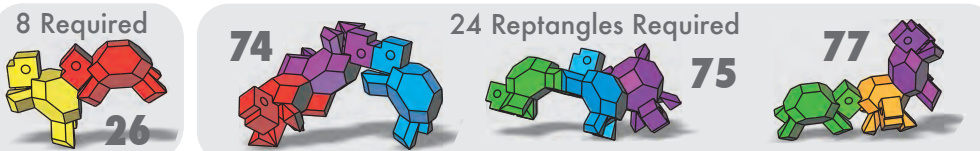
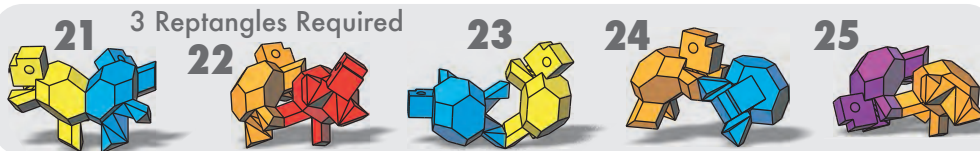
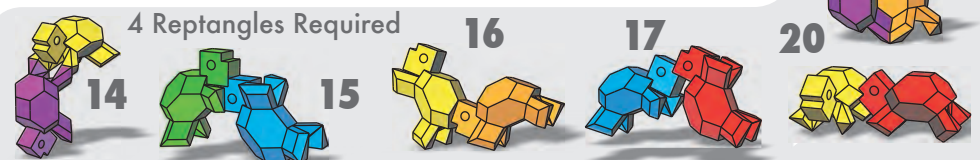
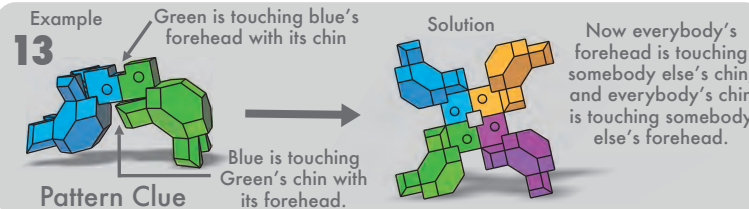
Reptangles match up across 3 mirror lines.



## ROTATION PATTERN PUZZLES

Refer to corresponding numbers found on pages 3-4 and 7-10

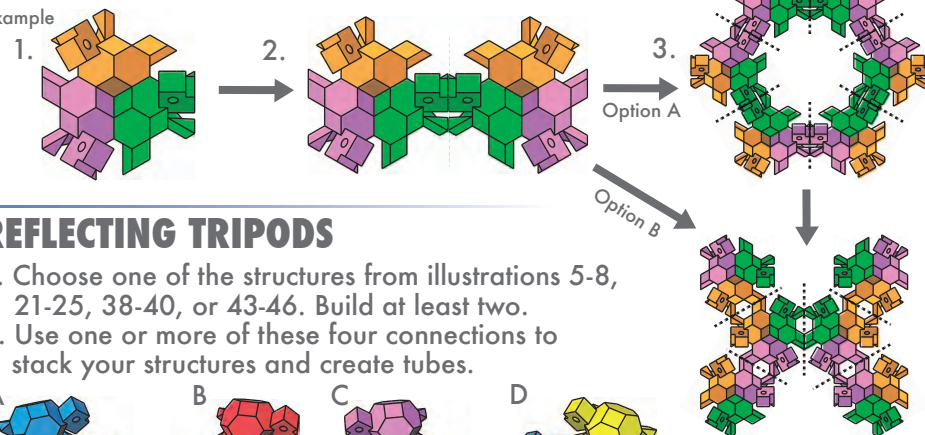
Add new Reptangles to the starter structure until every Reptangle in the structure makes exactly the same connections as every other Reptangle.



## REFLECTING TRIPODS

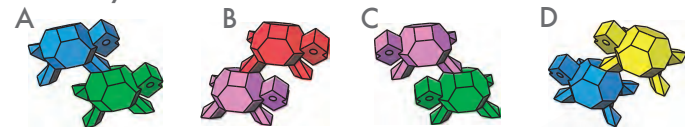
1. Build a tripod structure from page 4 (illustrations 21-25). Set your tripod on a flat surface so it can be viewed from the top.
2. Find a way to reflect the tripod by connecting 3 new Reptangles.
3. Continue reflecting one or more tripods at a time.  
As you see a pattern develop, continue building.

example

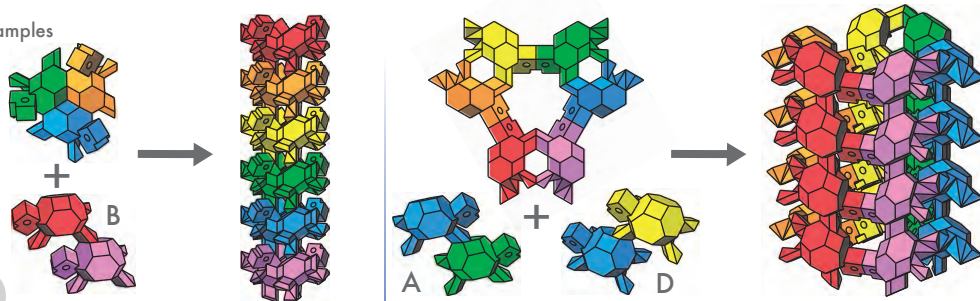


## REFLECTING TRIPODS

1. Choose one of the structures from illustrations 5-8, 21-25, 38-40, or 43-46. Build at least two.
2. Use one or more of these four connections to stack your structures and create tubes.



examples

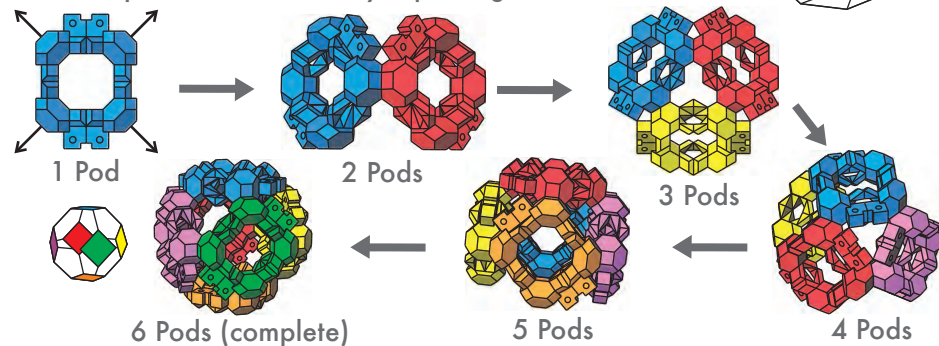


# BUILDING POLYHEDRA

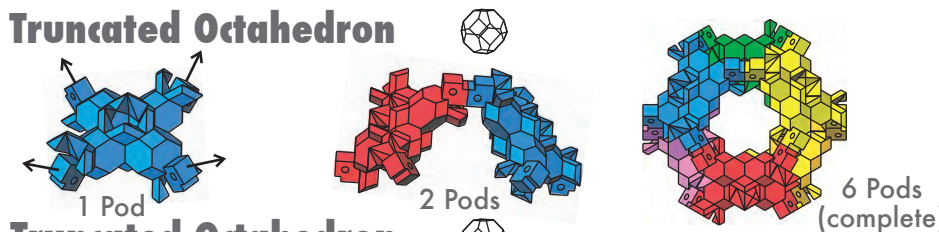
Build polyhedra with identical "pods" by repeating the same connections over and over.

## 68 Truncated Octahedron

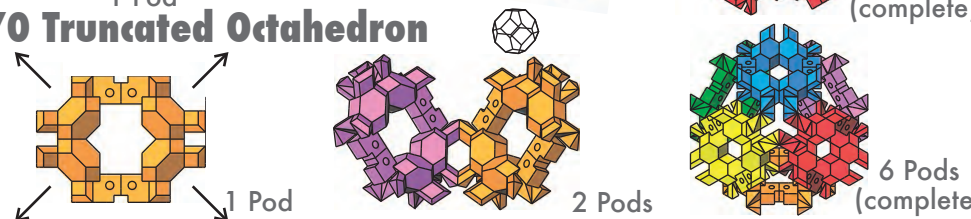
Connect each pod to four others by repeating these connections.



## 69 Truncated Octahedron

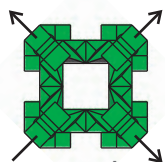


## 70 Truncated Octahedron

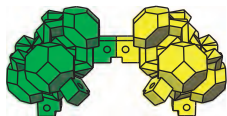




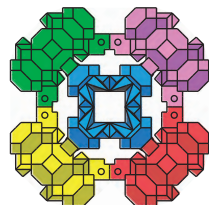
## 71 Truncated Octahedron



1 Pod

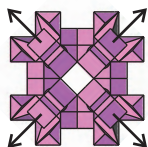


2 Pods



6 Pods (complete)

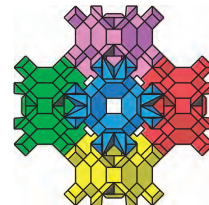
## 72 Truncated Octahedron



1 Pod

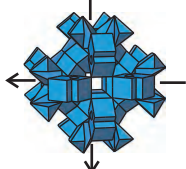


2 Pods



6 Pods (complete)

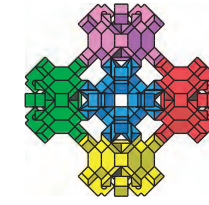
## 73 Truncated Octahedron



1 Pod

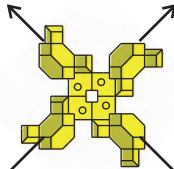


2 Pods

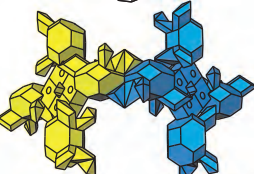


6 Pods (complete)

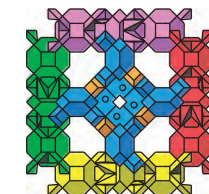
## 74 Truncated Octahedron



1 Pod



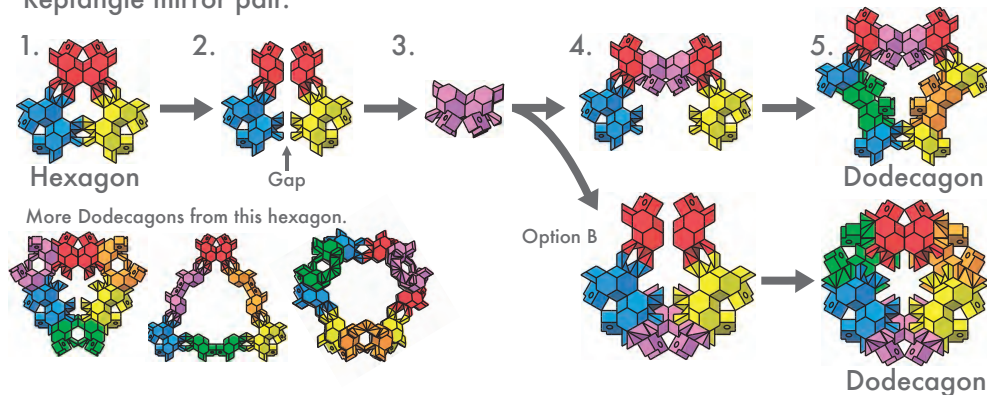
2 Pods



6 Pods (complete)

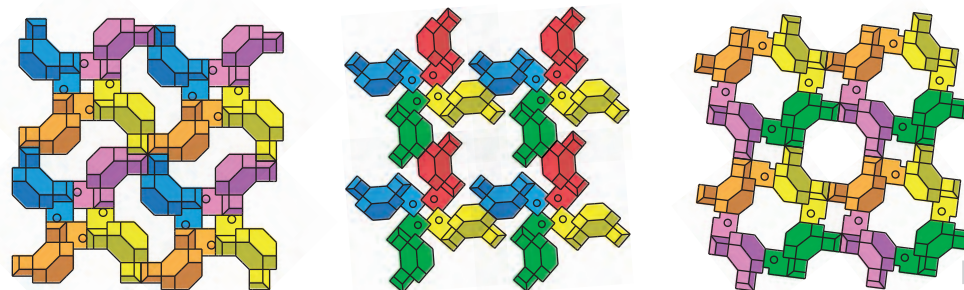
## HEXAGONS TO DODECAGONS

1. Build a hexagon from page 3 (illustrations 5-8). Place the hexagon on a flat surface so it can be viewed from the top.
2. Split the hexagon into mirror image halves. This will create two gaps.
3. Create a new Reptangle pair with reflective symmetry. (There are 7 different ways to build a mirror pair of two Reptangles.)
4. Find a way to bridge either of the two gaps in your structure by using your Reptangle mirror pair.



## HEXAGONS TO DODECAGONS

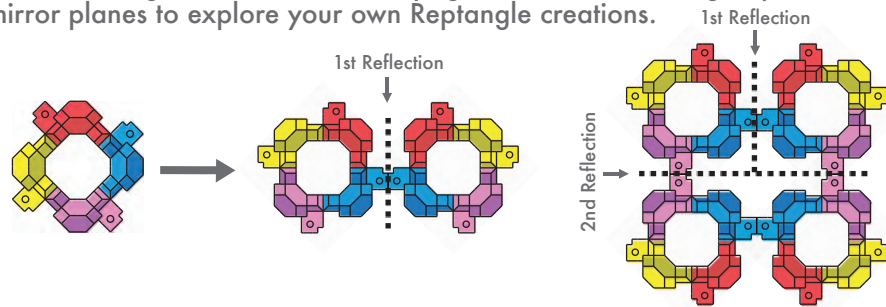
Choose a "rectangular" structure from page 3 and add different "translations."





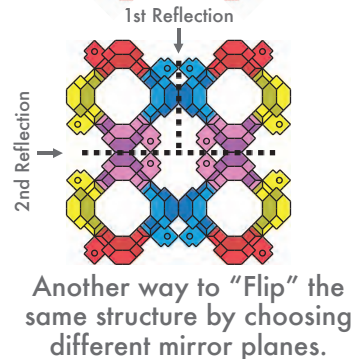
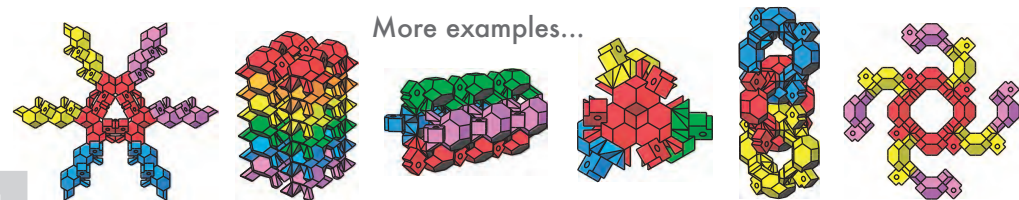
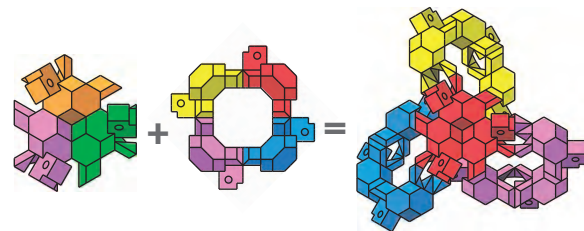
## REFLECTING RECTANGLES

Build "rectangular" structures from page 3, then reflect the groups on different mirror planes to explore your own Reptangle creations.



## COMBINATIONS

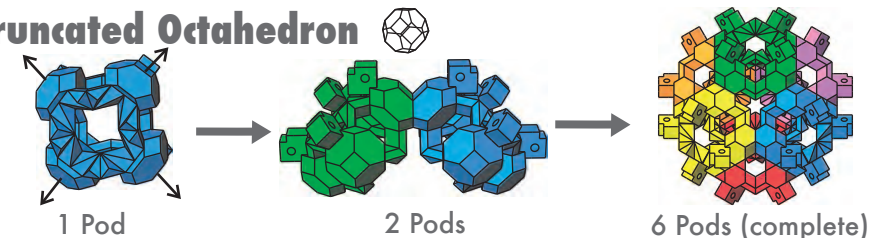
Pick out two or more structures. Combine the symmetries of the two and create a new structure.



## 75 Truncated Octahedron

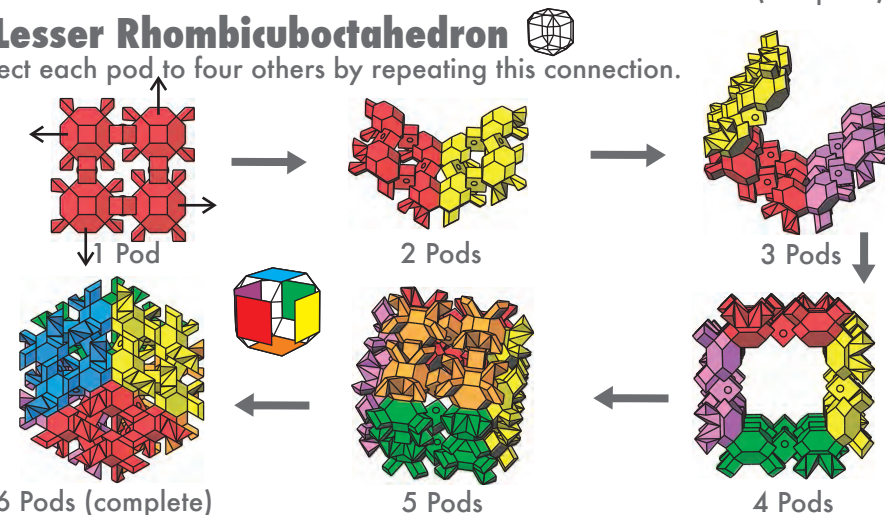


## 76 Truncated Octahedron



## 77 Lesser Rhombicuboctahedron

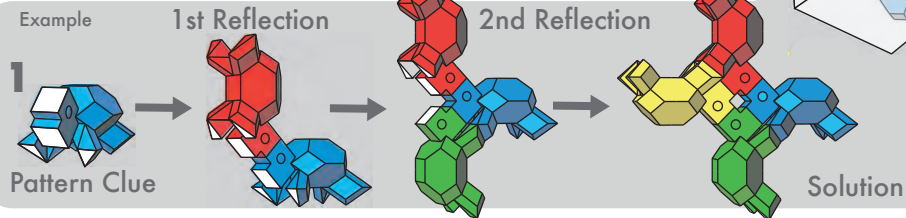
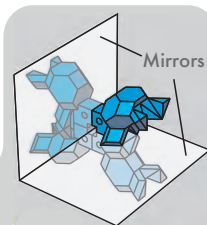
Connect each pod to four others by repeating this connection.



# REFLECTION PATTERN PUZZLES

Refer to corresponding numbers found on pages 3-10

Reflect Reptangles by connecting new Reptangles to the white surfaces. Continue until every Reptangle is reflected in this way. (Hint: Imagine that the white surfaces are touching mirrors.)



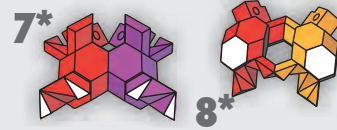
4 Reptangles Required



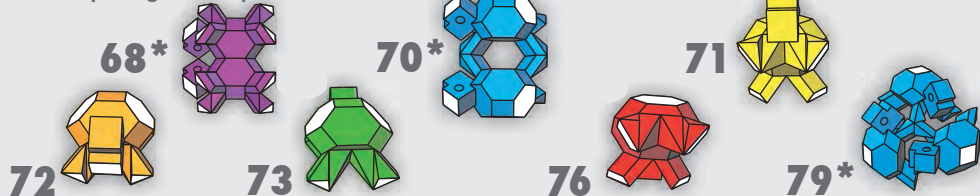
4 Reptangles Required



4-8 Reptangles Required



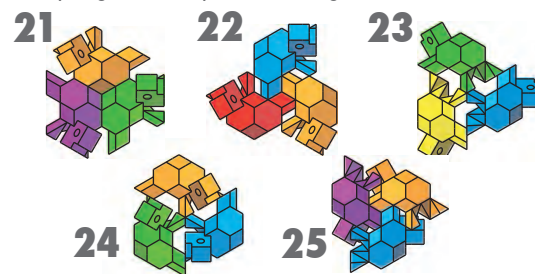
24 Reptangles Required



\*If the puzzle diagram shows a pair or group of Reptangles, reflect the entire group.

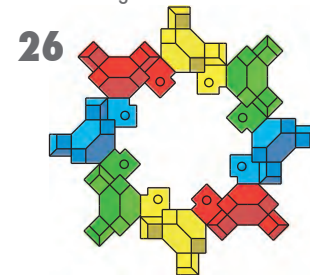
## 3rd Order Rotational Symmetries

Reptangles match up 3 times during one 360° rotation.



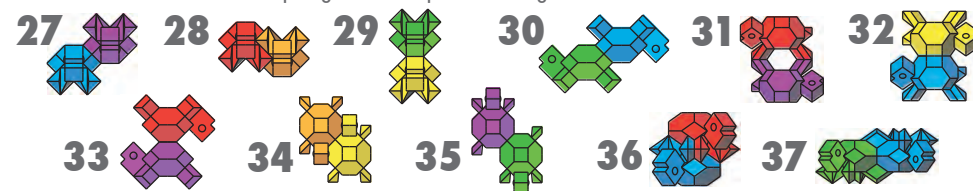
## 8th Order Rotational Symmetries

Reptangles match up 8 times during one 360° rotation.



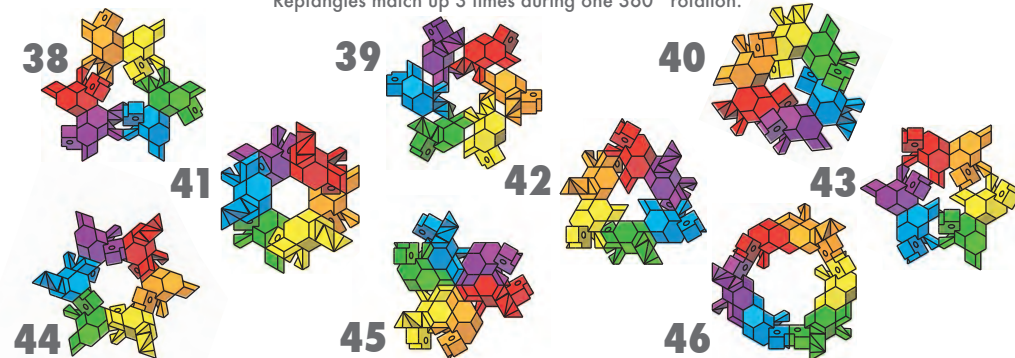
## 2nd Order Rotational Symmetries

Reptangles match up twice during one 360° rotation.



## 3rd Order Rotational Symmetries

Reptangles match up 3 times during one 360° rotation.



# EXPERT PUZZLES

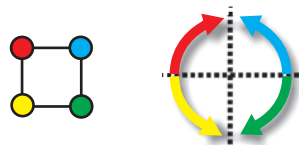
Very difficult!



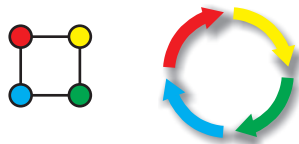
The Puzzle: Imagine that someone just handed you three Reptangles and said "I bet you can't connect these to make an equilateral triangle." That's the essence of these puzzles. No hints - just a tough challenge. You can struggle with them or use them to stump your friends.



2nd Order Rotational  
11 Solutions, page 4



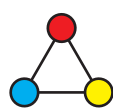
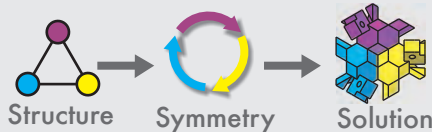
2-Fold Reflective  
7 solutions, some on page 3



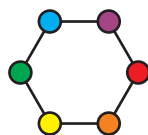
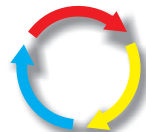
4th Order Rotational  
11 solutions, some on page 3

● = 1 Reptangle / = Connection

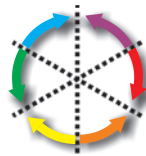
Example



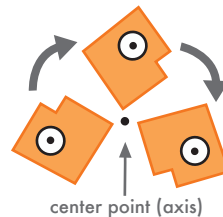
3rd Order Rotational  
5 solutions, page 4



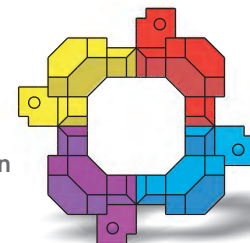
3-Fold Reflective  
4 solutions, page 3



## 3.ROTATIONS (turns)

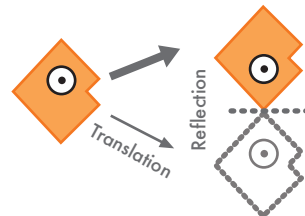


Reptangles with rotational symmetry "match up" when you turn them around a center point (axis)

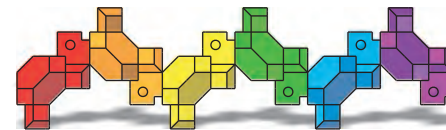


Rotational Symmetry  
4th Order 90° turns

## 4.GLIDE REFLECTIONS (slide+flip)

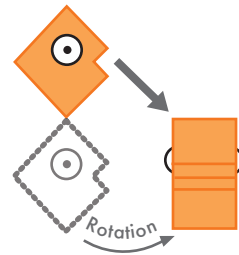


Reptangles with glide reflective symmetry "match up" when you translate (slide) and reflect (flip) them.



Glide Reflective Symmetry

## 5.GLIDE ROTATIONS (slide+turn)



Reptangles with rotation symmetry "match up" when you translate (slide) and rotate (turn) them.



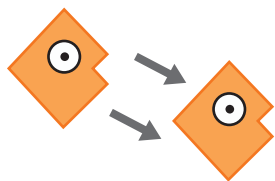
Glide Rotational Symmetry



# THE BASIC MOVES

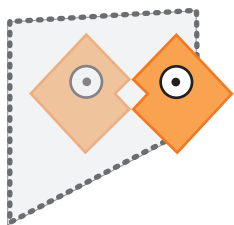
When you build with Reptangles™, each new turtle added represents a geometric transformation of the Reptangle that came before it. Think of a transformation as a specific way of “moving” a Reptangle. In this booklet, we refer to 5 types of transformations.

## 1. TRANSLATIONS (slides)

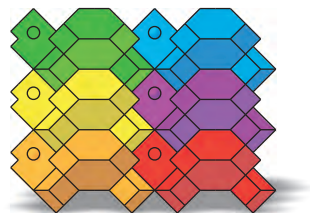


Reptangles with translational symmetry “match up” when you slide them. A translation does not change the way a Reptangle is pointing.

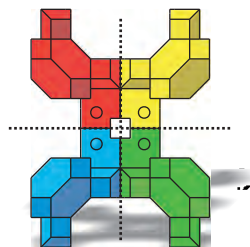
## 2. REFLECTIONS (flips)



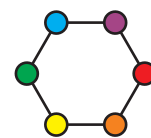
Reptangles with reflective symmetry “match up” when you flip across mirror lines or mirror planes (dotted lines).



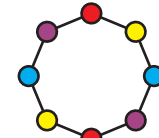
Translational Symmetry



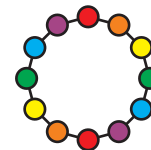
Reflective Symmetry  
2-fold



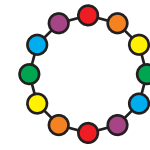
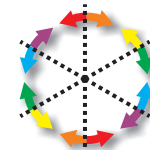
3rd Order Rotational  
9 known solutions, page 4



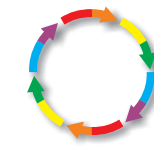
8th Order Rotational  
1 solution, page 4



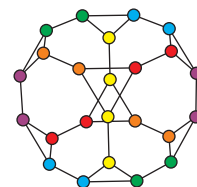
3-Fold Reflective  
Many solutions, some on page 12



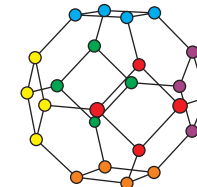
6th Order Rotational  
1 known solution, page 4



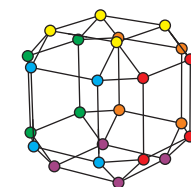
## POLYHEDRAL STRUCTURES (Various Symmetries)



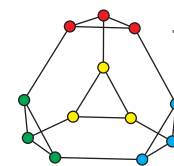
Truncated Cube  
1 known solution, page 9



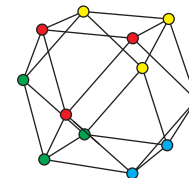
Truncated Octahedron  
9 known solutions, page 5-8



Lesser Rhombicuboctahedron  
1 known solution, page 8



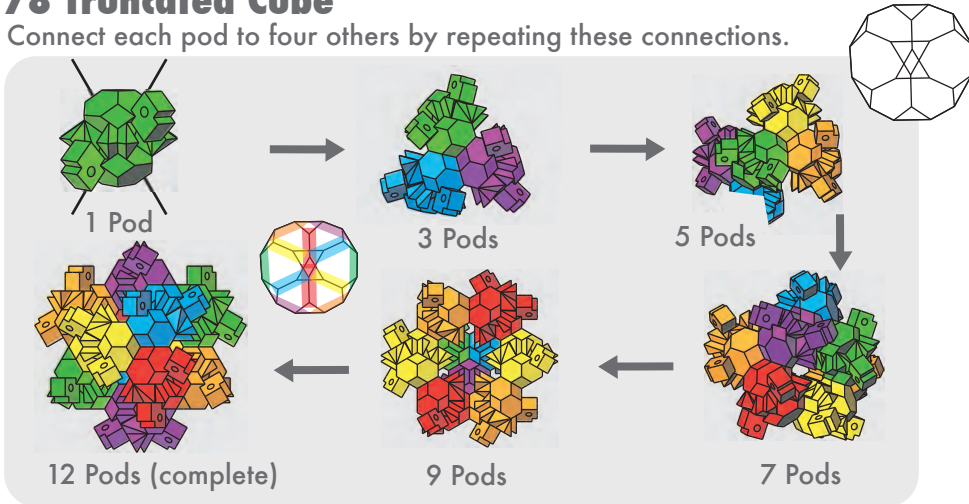
Truncated Tetrahedron  
2 known solutions, page 10



Cuboctahedron  
1 known solution, page 10

## 78 Truncated Cube

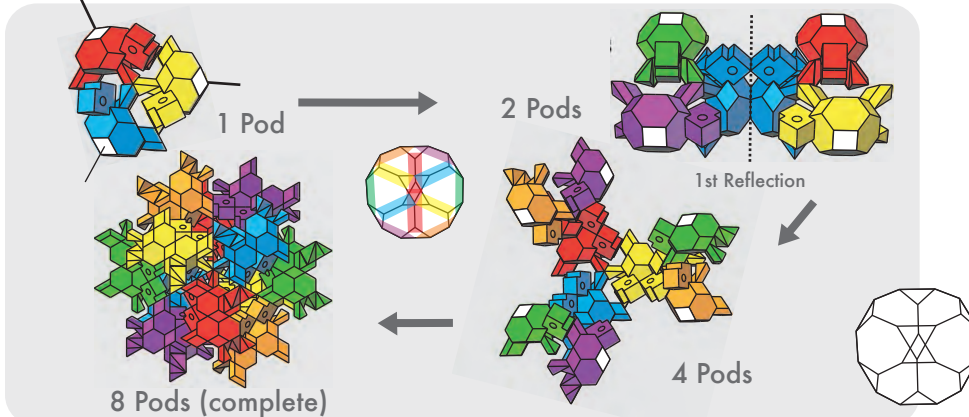
Connect each pod to four others by repeating these connections.



## 79 Truncated Cube

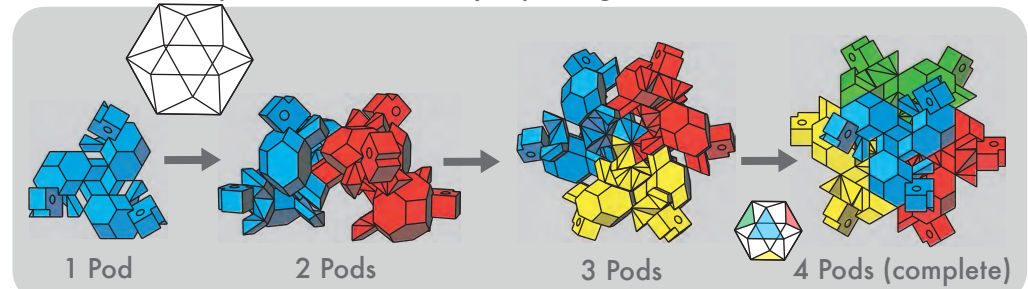
Connect each pod to three others.

Connect these white surfaces, thereby reflecting pods.



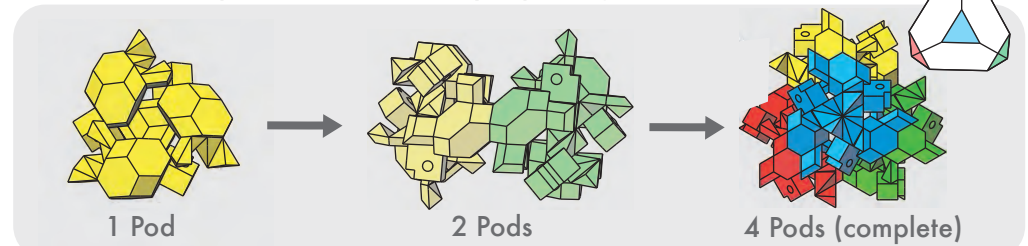
## 80 Cuboctahedron

Connect each pod to three others by repeating this connection.

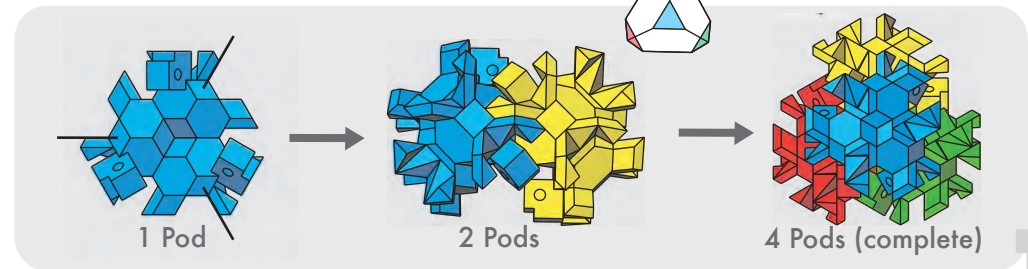


## 81 Truncated Tetrahedron

Connect each pod to three others by repeating this connection.



## 82 Truncated Tetrahedron



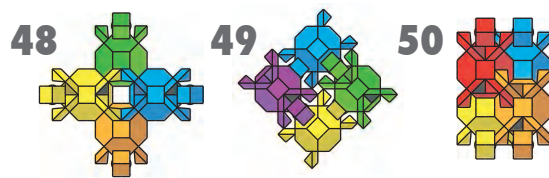
## 6th Order Rotational Symmetries

Reptangles match up 6 times during one 360° rotation.

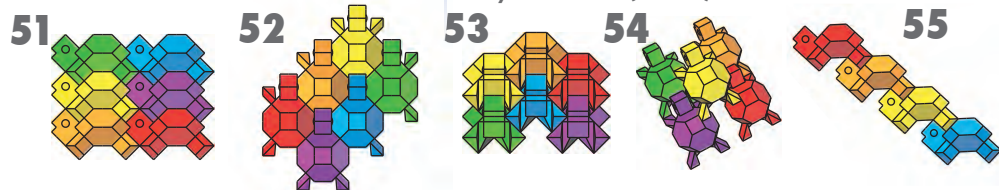


## 2nd Order Rotational Symmetries

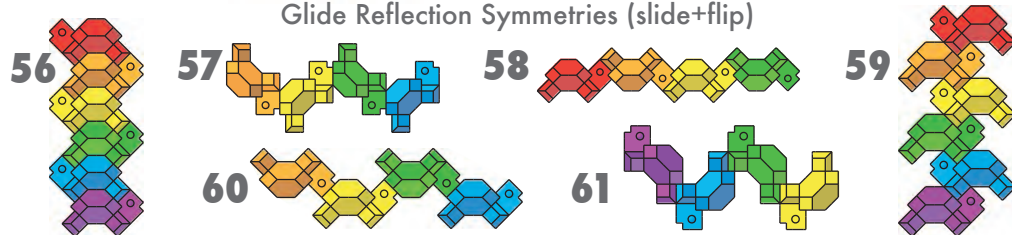
Reptangles match up twice during one 360° rotation.



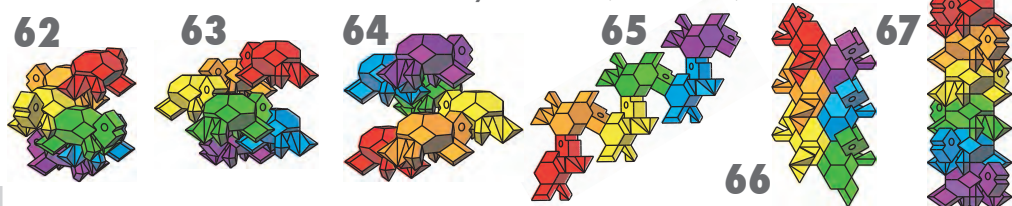
## Translational Symmetries (slides)



## Glide Reflection Symmetries (slide+flip)

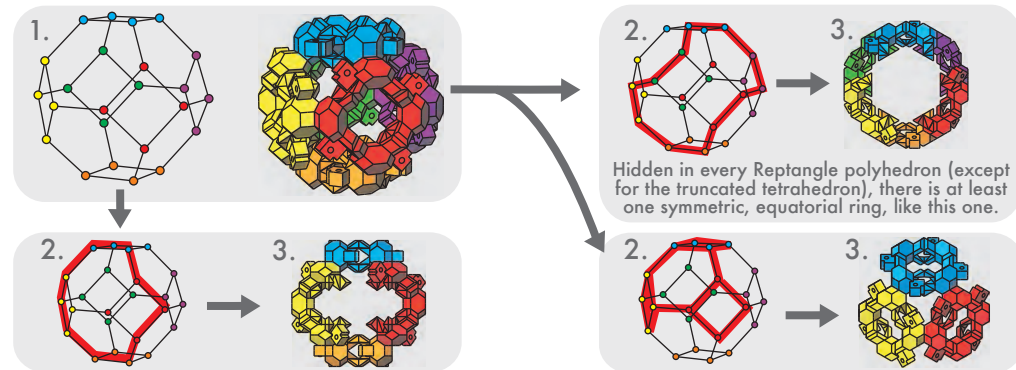


## Glide Rotation Symmetries (slide+turn)



## DISSECTING POLYHEDRA

1. Build any polyhedron from illustrations 68-82.
2. Look for symmetric designs within your polyhedron (see red outlines).
3. Remove those structures or build from scratch.



## COLOR PATTERN CHALLENGES

- Challenge 1 Arrange the Reptangles in any polyhedron from illustrations 68-82 so that no similar colors touch. For illustrations 80-82, limit yourself to only four colors.
- Challenge 2 Arrange the Reptangles in any polyhedron illustrations 68-82 so that all similar colors are contiguous. Use all six colors. For illustrations 68-77, find a new way to do this.

