

Montshire at Home: Teacher Guide

WEEKLY THEME: PUZZLES – Energize your students’ brains with all types of puzzles that promote problem solving, lateral thinking, geometry skills, and more.

MONTSHIRE AT HOME is a series of learning activities, resources and short videos, developed, hosted and curated by the Montshire’s Education team. It’s designed to support children, families, and teachers with easily accessible concepts, content, and materials while learning at home.

Teachers can use these materials to support remote science learning opportunities for their students at home. Below is a suggested learning progression using this week’s theme, activities, and resources found on the Montshire’s Online Resource web page.

SUGGESTED LEARNING PROGRESSION

Day 1: Tangrams

EXPLORE

- ▶ How the same seven pieces create so many different pictures.
- ▶ How shapes can be put together to make new shapes. For example, two triangles can make a bigger triangle, a square, a parallelogram, or more.

DISCOVER

- ▶ Tangrams encourage spatial skills. As you figure out how the pieces best fill the space, you are also developing your ability to understand space.
- ▶ Tangrams are a very old puzzle, thought to have originated in China around 1,000 years ago.
- ▶ Different geometric terms, such as rotate, adjacent and parallelogram, as you solve a puzzle.

EXTENSIONS

- ▶ Design your own tangram puzzles for others to solve. Lay out your pieces to make a picture and then trace around them. Mix up the pieces and then have someone else try to solve.

Day 2: Solving a Puzzle

EXPLORE

- ▶ What are the steps of solving a puzzle?
 - 1. Understand the problem:** Read the challenge and observe all the parts of the puzzle. Make sure you understand the goal.
 - 2. Strategize:** Before you get started, think about the different ways you can solve the problem. Think about it logically but also think outside the box (i.e., be creative)!
 - 3. Stick with it:** Follow your strategy to try and solve the problem.
 - 4. Reflect:** Did you solve it? Think about what worked and what didn’t. Try a new strategy.
 - 5. Repeat!!!**

DISCOVER

- ▶ Something seemingly simple, can require lots of trial and error before you figure out the solution.
- ▶ Solving a puzzle makes you feel great satisfaction and happiness!

Day 3: Games for One or Two Players

EXPLORE

- ▶ Have fun with a family member or play a solitaire style puzzle on your own.
- ▶ Develop a stronger strategy the more you play.

DISCOVER

- ▶ There are so many great games to discover. Try a new one each day and share your favorites.
- ▶ Once you have played a game, discuss your strategy with your opponent. Did they approach the game in a different way? What can you learn from each other?

Day 4: Toothpick (aka Matchstick) Puzzles

EXPLORE

- ▶ Use toothpicks, pencils, twigs, or any small straight object you have a bunch of.
- ▶ Follow the clues to solve the puzzle. Remember, be creative!

DISCOVER

- ▶ Puzzles of this type are great for developing lateral thinking. Lateral thinking is that “outside-of-the-box” thought that requires us to come up with creative, as opposed to logical, solutions.

Day 5: Handcuff Puzzle

EXPLORE

- ▶ How seemingly impossible puzzles are solvable once you start to think of them in a new way.
- ▶ Check out how the handcuff puzzle is connected to your wrist. Could you slide something under the loop? Could you slide part of your partner’s rope under the loop and around your hand?

DISCOVER

- ▶ Disentanglement puzzles fall into a field of mathematics called topology. Topology relates to how fundamental principles of an object stay the same even when an object is distorted, such as squished, twisted or entangled.

EXTENSIONS

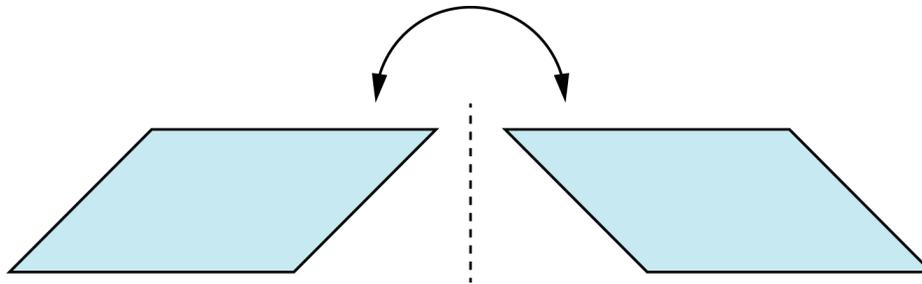
- ▶ Möbius strips are another great way to explore an interesting geometric modification.



Activity: Tangrams

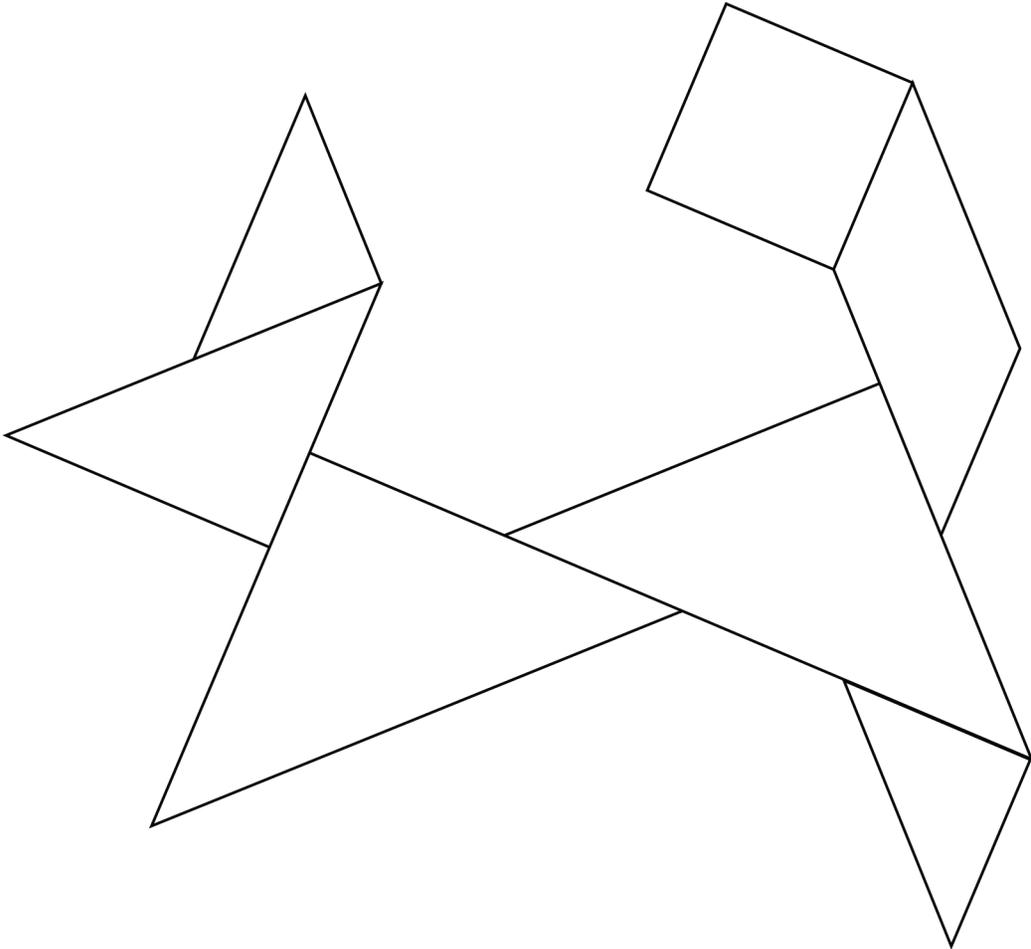
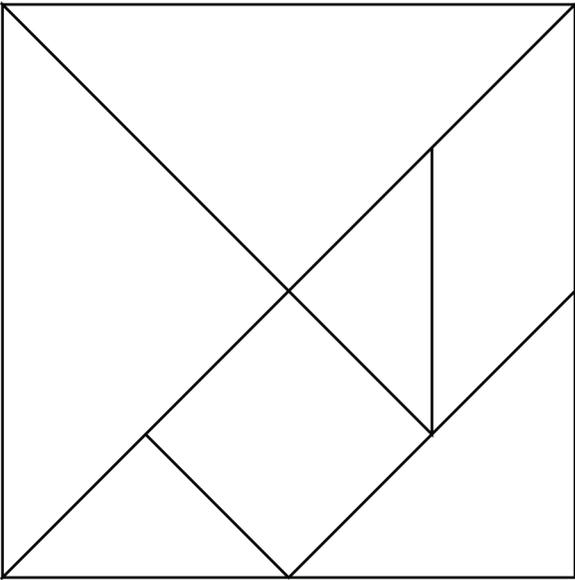
Tangrams are a great puzzle that work for both beginner and advanced puzzlers.

- ▶ Tangrams were thought to have originated in China around 1,000 years ago and were introduced to Europe and America in the 1800s. Puzzle pieces are created by cutting up pieces of a square. They've been made of a variety of materials throughout history. These pieces can then be rearranged to create shapes and pictures.
- ▶ Geometric puzzles like this help to develop spatial skills, as well as understanding of geometric terms. And most importantly, they make you a better problem solver!
- ▶ Of all the shapes in a tangram, the parallelogram is the most interesting. When you flip any of the other pieces over, they fill the same space. However, when you flip over the parallelogram, it doesn't fill the space in the same way and points in the opposite direction because it isn't a symmetrical shape. Sometimes you need to flip this shape to make it fit.

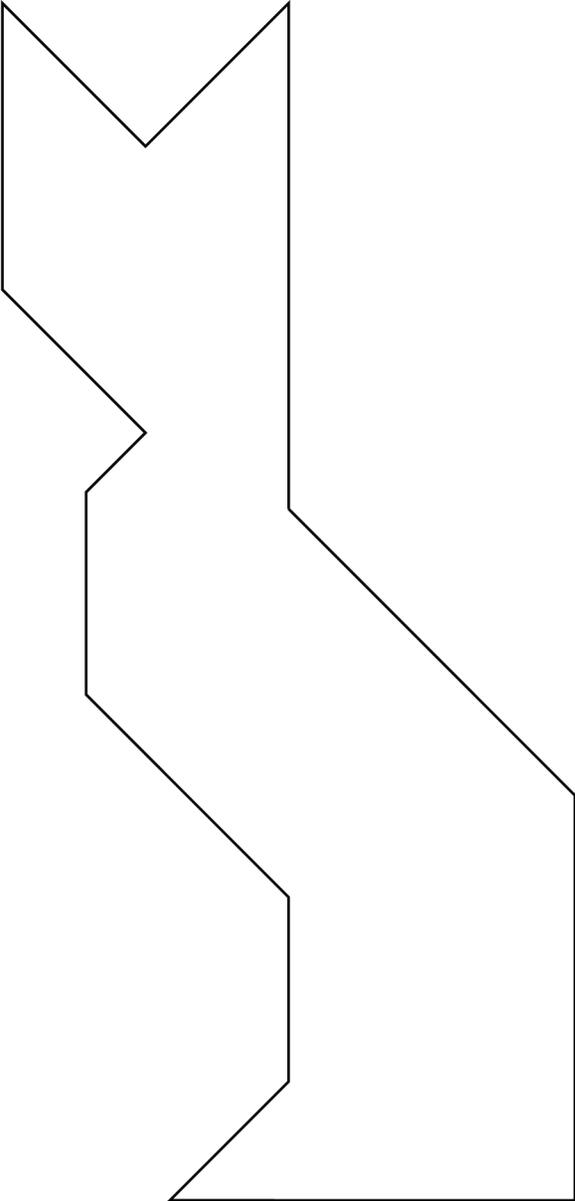
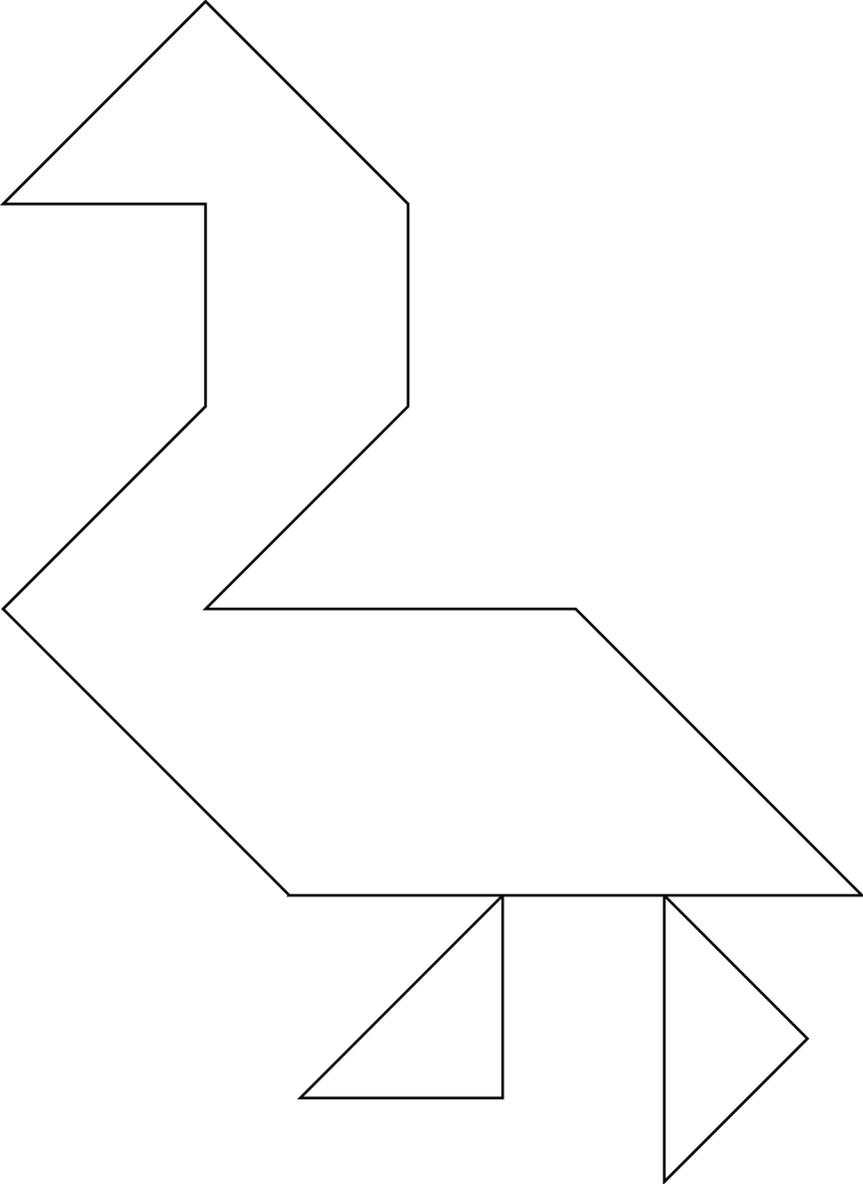


- ▶ Choose your difficulty level. Print your puzzle on colorful heavy weight paper or craft foam. Then begin working on some tangrams!

Tangram piece template and puzzle.



More puzzles!





Activity: The Montshire Cube

Puzzles can help you:

- ▶ Develop spatial and geometry skills.
- ▶ Make the more creative side of your brain work with the more logical side through abstract and quantitative thought.
- ▶ Strengthen problem solving skills, such as making predictions, testing, and adjusting ideas and plans.
- ▶ Develop patience.
- ▶ Relax.
- ▶ Feel a great sense of accomplishment when you (finally!) solve a puzzle.

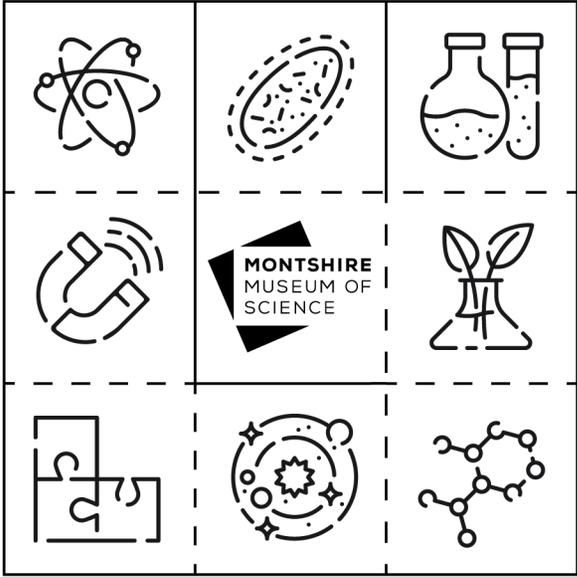
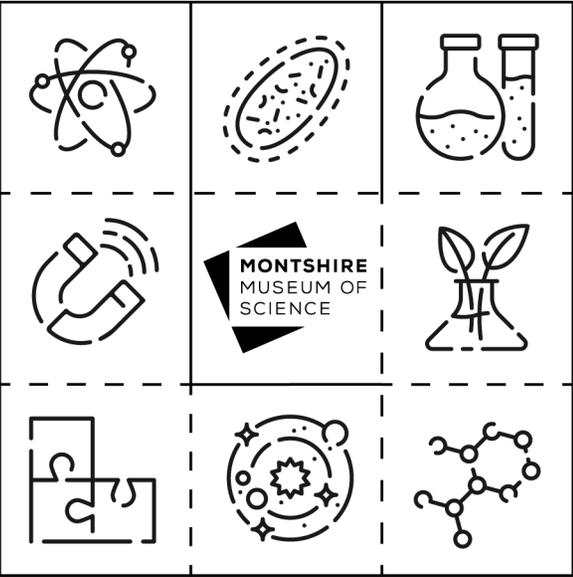
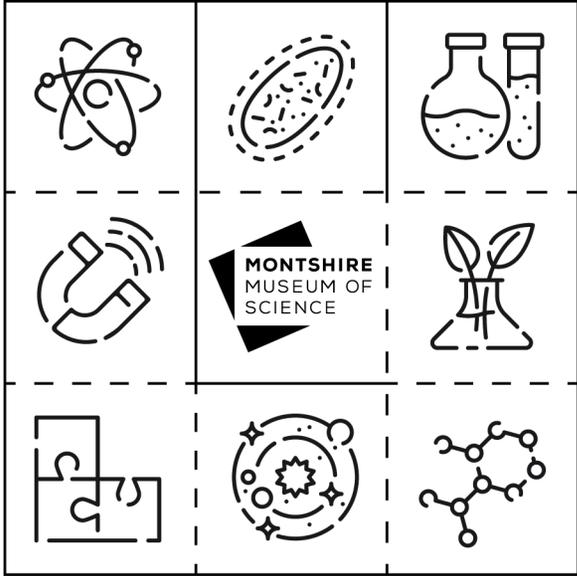
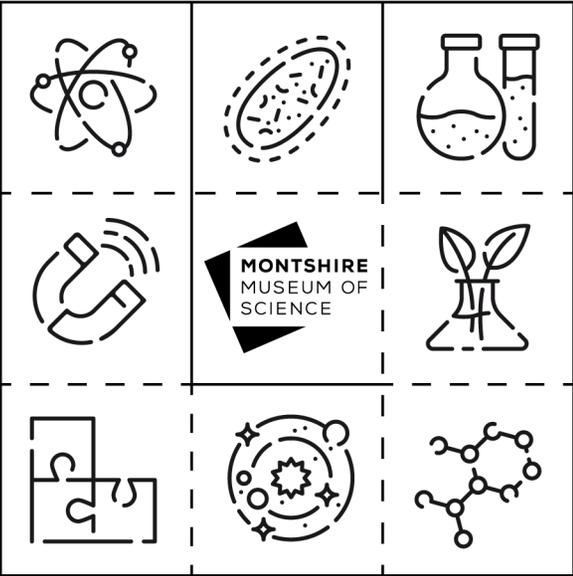
Instructions:

1. Cut out the square.
2. Cut on the solid lines.
3. Fold on the dotted lines (either forward or backward).
4. Fold the puzzle so that you create a cube that has paper on all sides.

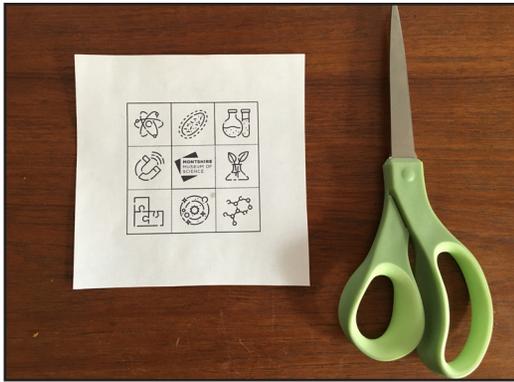
Solutions

- ▶ There are multiple solutions to this puzzle, which are all just slight variations of each other. You can create a cube that has an image on all sides or no sides. There is also a solution that has 5 visible images and one blank side or 5 blank paper sides and one image visible.
- ▶ We won't give you the solution to this one, but recommend that you keep pulling it out every now and then and try folding it in different ways. Once you solve it, think about what was different about how you folded it this time.

Cube Template

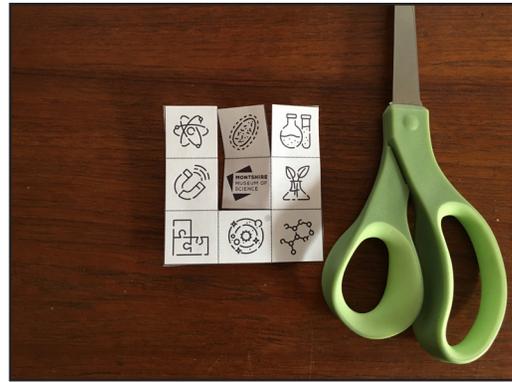


The Montshire Cube Instructions

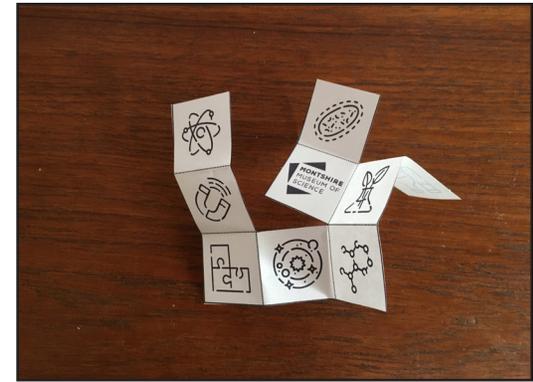


Materials:

- ▶ Cube template
- ▶ Scissors



1. Cut out the square and cut on the solid lines.



2. Fold forward or back on the dotted lines to create a cube with paper on all sides



3. Oops, not quite yet.



4. Got it!

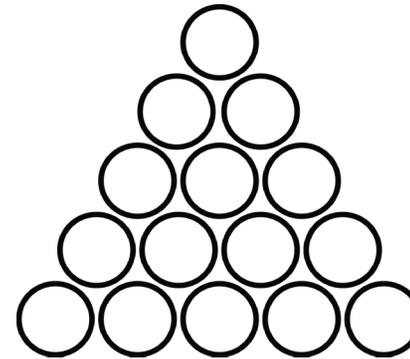


Activity: Peg Solitaire Puzzles

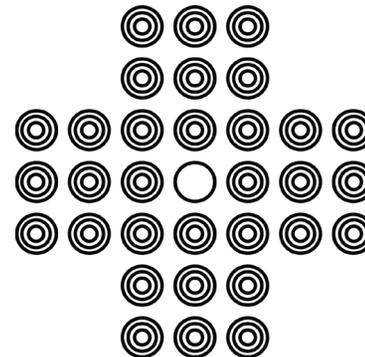
Here is an easy game to make, but a hard one to solve! It's from a group of puzzles called peg solitaire or brainvita. These games require you to develop a strategy to improve each time you try and solve it. Computer scientists have developed mathematical programs for how to best solve these types of puzzles.

Instructions

1. Select a game board (2 examples shown)
2. Fill in the spaces on the board with tokens, beans or pennies.
3. Leave the center hole open on the cross pattern or any hole on the triangle pattern.
4. To begin, jump one token over the one next to it and on to the empty space. Remove the token you jumped over.
5. Continue jumping on to open spaces until you can do no more jumps.
6. The object is to clear the board of all tokens except for one.



Board 1 (leave any spot blank to start)

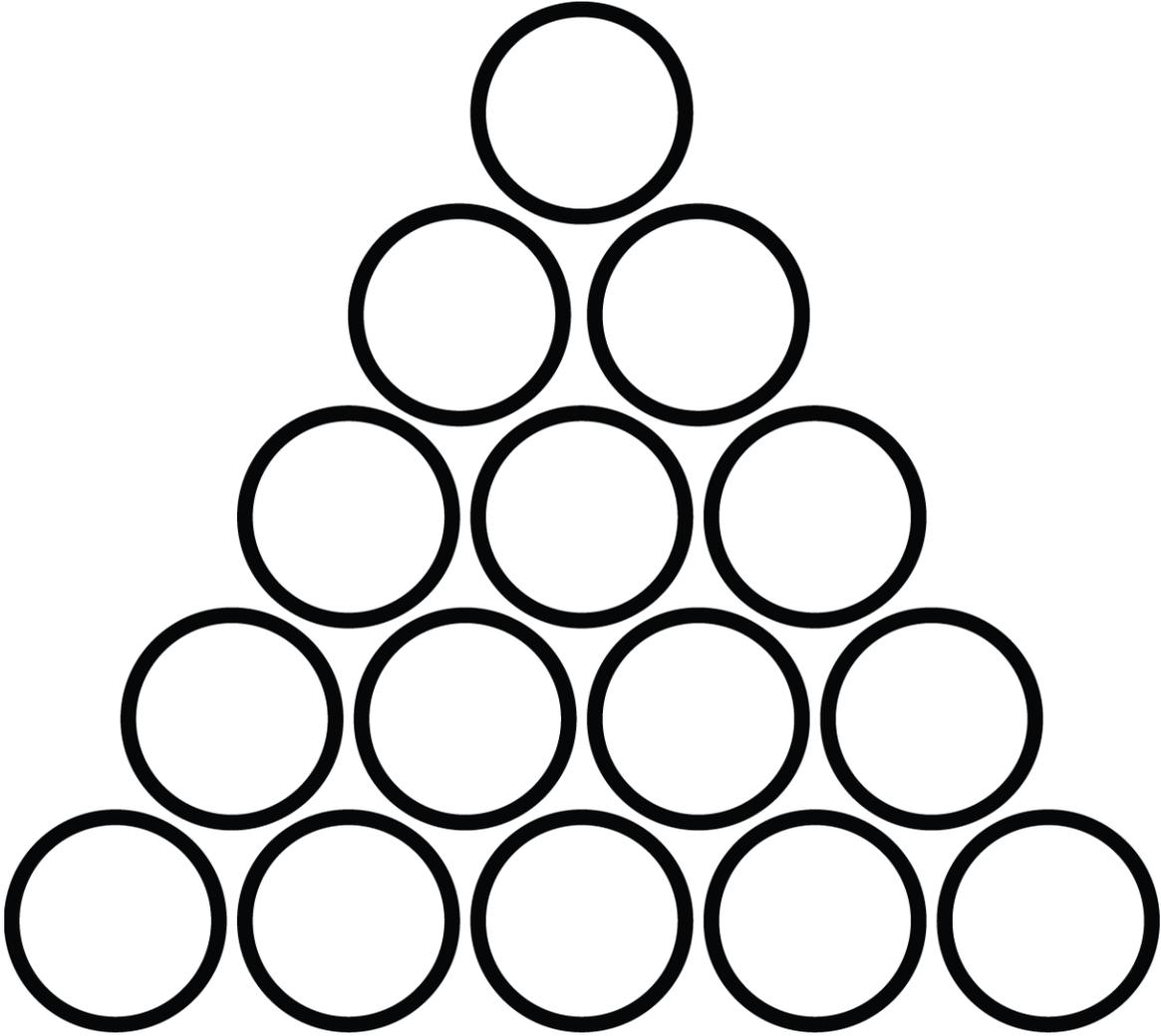


Board 2 (leave the center spot empty)

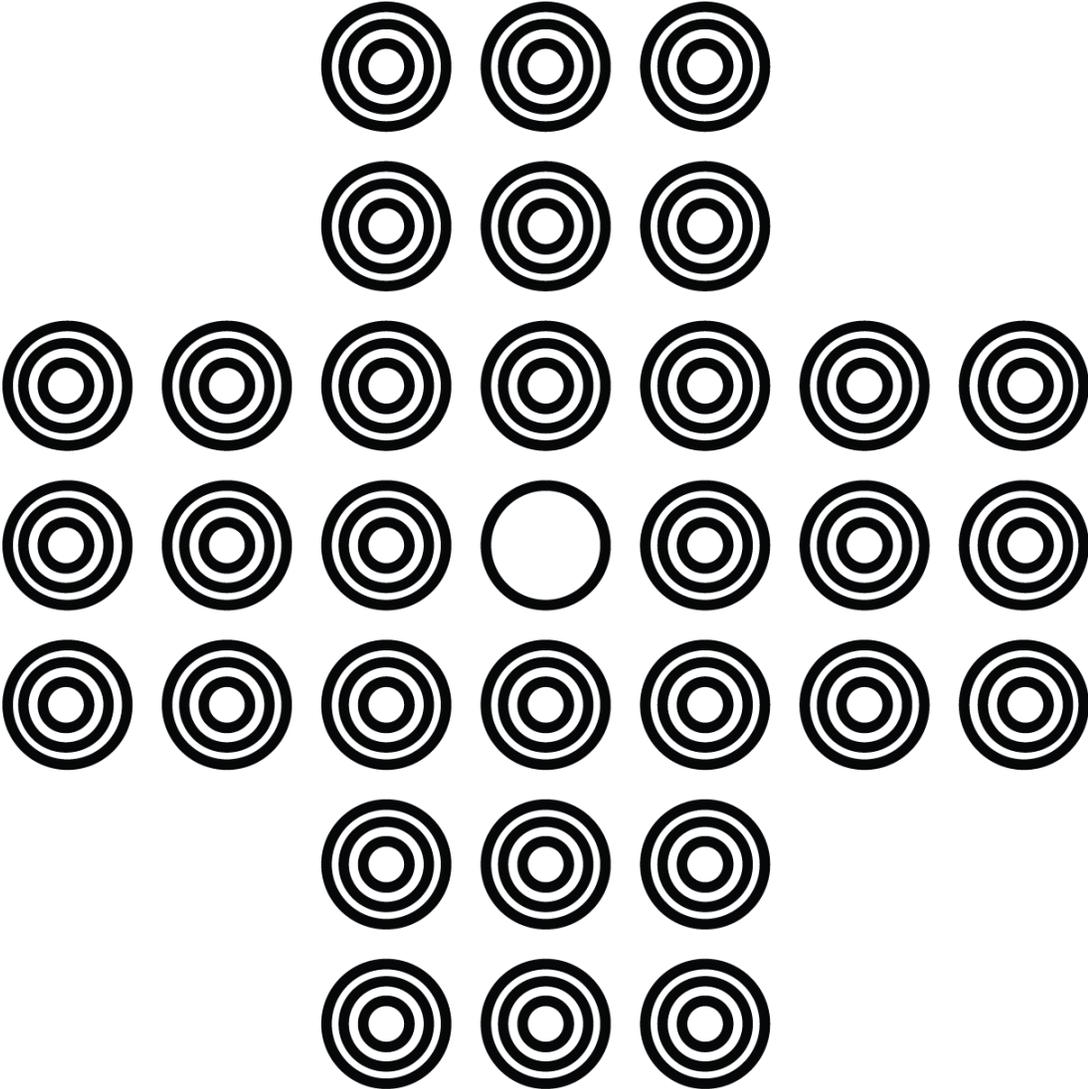
Variations

Choose a different empty starting hole.

Board 1 (leave any spot blank to start)



Board 2 (leave the center spot empty)





Activity: Toothpick Puzzles (aka Matchstick Puzzles)

Toothpick puzzles, otherwise known as matchstick puzzles, are a rearrangement puzzle. You need to look for patterns and shapes. Additionally, some of these puzzles require lateral thinking. Lateral thinking is a thought process that requires a creative approach as opposed to a purely logical approach.

Materials

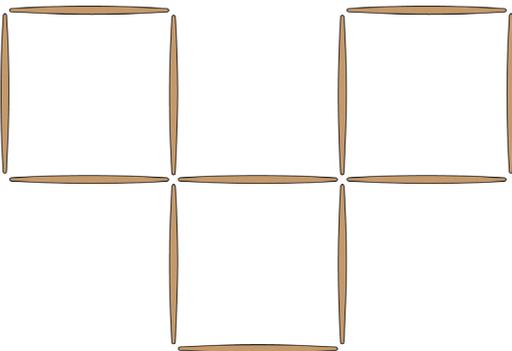
- ▶ Toothpicks, pipe cleaner pieces or other objects similar in size to a matchstick

Instructions

1. Set up your sticks to look like the starting picture.
2. Follow the rules (usually how many sticks you can move) to make a new picture.
3. Remember to think creatively!

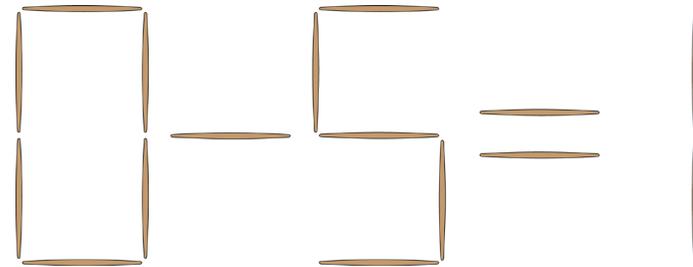
Example 1

- ▶ Move 3 sticks to get 5 squares



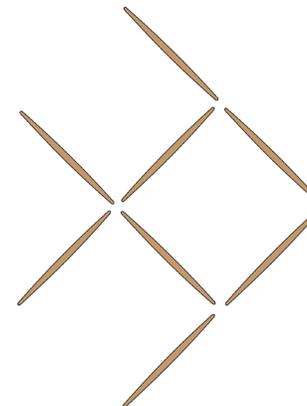
Example 2

- ▶ Move one stick to make the equation correct



Example 3

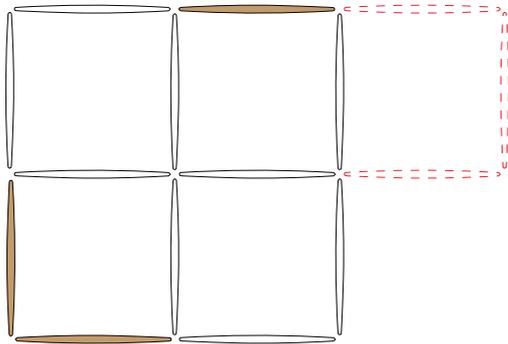
- ▶ Change the picture so the fish is swimming in the opposite direction by only moving 3 sticks



Answer key

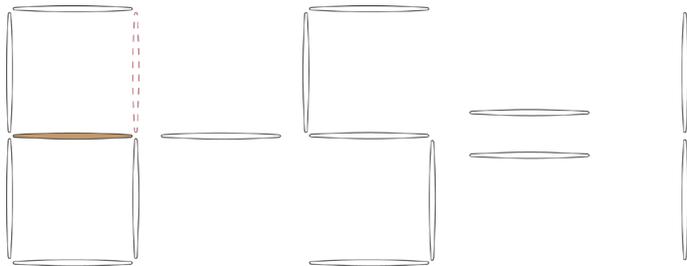
Example 1

- ▶ Move 3 sticks to get 5 squares



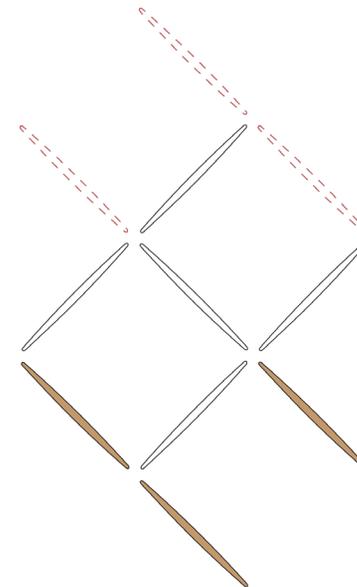
Example 2

- ▶ Move one stick to make the equation correct



Example 3

- ▶ Change the picture so the fish is swimming in the opposite direction by only moving 3 sticks





Activity: Disentanglement Puzzle: Handcuff Puzzle for Two People

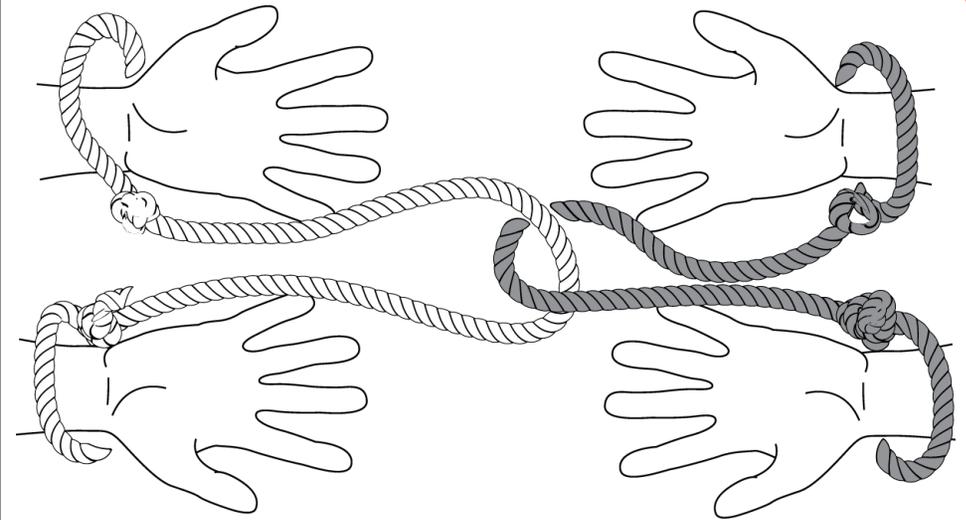
The Handcuff Puzzle is a type of disentanglement puzzle that requires you to take apart or untangle parts of puzzles that aren't completely attached. This type of puzzle falls into a study of geometry called topology—the mathematics of distortion.

Materials

- ▶ 2 lengths of string or cord that span your arms outstretched

Instructions

1. On the ends of both strings, tie loops that are large enough to easily slip your hands through.
2. Have one person put a hand into each loop on the end of their string.
3. Have the second person put a hand in one string loop. Then, take their string and wrap it around their partner's string before putting their second hand in the second loop. This way your two strings are crossed.
4. Try to get unconnected without taking off (or cutting) the handcuffs!

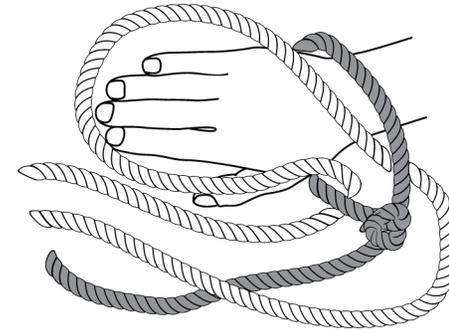
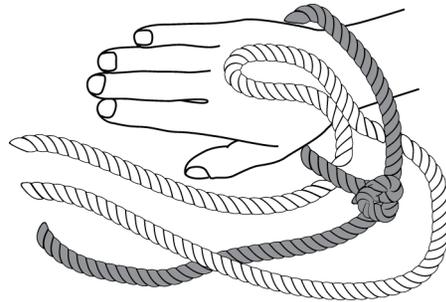


Hint (Don't look at this until you have tried for a while!)

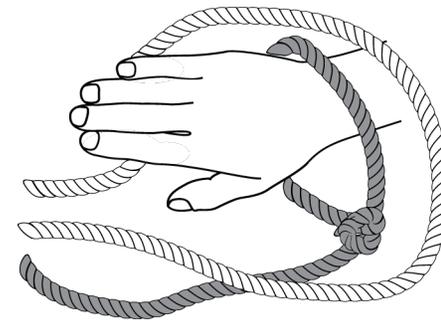
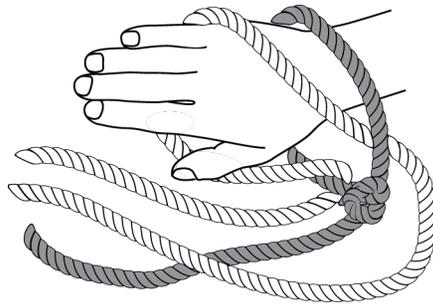
- ▶ Look at your wrists. Is there space between the loop and your wrist? We can't pull our hand out but could you put the string through the loop in some way?

Solution

1. Slide the loop of one person's string through the other person's wrist loop. Pull a good amount of string through.



2. Slide that loop over the other person's hand, and pull it back under that person's wrist loop.



3. Pull away, the string is untangled!

