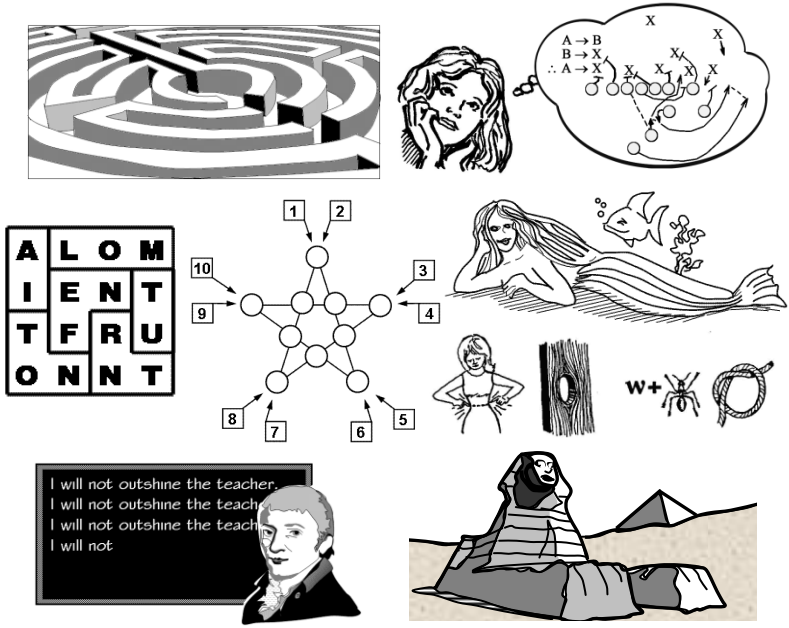
Brain Trainer

Puzzles to Keep Your Mind Young and Agile



by William Armstrong

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Orientation – Meet Your Personal Trainer

Like any other part of your body, your brain needs exercise to stay fit and agile. Puzzles provide a fun and fascinating workout for your mind. However, most puzzle books fail to explain how to exercise your gray matter; they ask you to bench press 400 pounds without any training or preparation. Think of this book as your personal puzzle trainer. It not only presents you with hundreds of enjoyable brain exercises, it also teaches you how to improve your skills so you can tackle the toughest challenges.

Each chapter covers a different puzzle genre, which acts as another piece of equipment in your "mental workout" gym. Some of the puzzles provide mind-stretching warm-ups, while others work specific skills like visualization or flexibility. The variety of different puzzle types will help you find the areas that you enjoy most. The training and repetitions will help you take on greater challenges as you gain strength.

Here's how I've organized each chapter:

A playful story launches each puzzle category. The stories generally put the topic into historical perspective, but they're also designed to evoke a laugh or two. In his book ***A Whole New Mind***, Daniel Pink stresses how 'story' plays an important role in a healthy, creative mind.

He also emphasizes 'play' as another facet of our mental training. So I hope that the stories introduce each topic in an amusing way. If you don't share my sense of humor, feel free to skip to the meat of the chapter.

Next I define the puzzle category as briefly as I can and try to get you into some basic exercises right away. I find that I learn best through examples, so be prepared for lots of sample puzzles. I will try to explain how to approach each puzzle in enough detail so that you are not overwhelmed. If the first puzzles are too easy, rest assured that they get tougher as you go. By the end of each chapter you'll be faced with some daunting challenges. Even if you don't care for the most difficult problems, you might enjoy studying the answers that explain how each puzzle can be solved.

As we go step by step through the mental exercises, we'll build a list of puzzle-solving tips. If you ever get stumped, try applying some of these hints. Each chapter also presents a General Puzzle Principle that I hope will help you solve any puzzle. In this way, your "trainer" can help you develop an effective approach to all of the brain exercises you encounter. Here is one of the general principles to get you started:

Don't give up. "Think positive." Assume you'll succeed. You are halfway to victory when you know that you <u>can</u> solve the puzzle. Solutions appear when you are confident that they will. Remember that it's not over until you win.

I explain each puzzle's answer in detail at the end of the book. My answers often include suggestions of how the puzzle exercises your neurons. Even if you solved the puzzle with ease, you may want to examine how I approached it; studying how other people overcome obstacles helps you collect a variety of tools for handling more difficult challenges.

At the end of each chapter I'll refer to a few books, magazines, and web sites where you can continue your training (and fun). This book is just the beginning of a life-long adventure. I hope it assists you in finding the types of puzzle that make it fun to exercise your brain. Ultimately, I want to encourage you to create your own puzzles for the rest of us to enjoy. Creating puzzles exercises your brain as much or more than solving them.

Here are some of the brain functions that the puzzles will be exercising. The icons are shorthand symbols that I'll display after each puzzle's title to suggest which functions that particular puzzle addresses. I only have room for two or three icons per puzzle, and some functions will depend on how you approach the problem.

Left Brain	***Right Brain***
Logical/sequential 	 Lateral/random
Rational 	 Intuitive
Objective 	 Subjective
Analysis 	 Synthesis
Details 	 Big picture
Exact calculations	 Quick approximations
Lists/Plans 	 Story/fantasy
Rules/Procedures 	 Creative
Spelling/Vocabulary 	 Visualizing
Control 	 Pattern Recognition
Language/verbal skills 	 Images/symbols

Full Brain Facilities

 Memory/Recall

Focus/Attention 

 Speed/Quick Thinking

Association 

 Learning/New Concepts

What Makes a Good Puzzle?

1. **A puzzle must be solvable.** There must be a way to figure out the answer. Ideally the solution should be clever and entertaining, but there absolutely must be an approach one can take to tackle the problem. Here's an example of an unfair question that doesn't meet my definition of a puzzle:

   > The word "committee" has three sets of double letters (m's, t's, and e's). What is another common word that has three sets of double letters ***in a row*** (with no intervening letters like the "i" in "committee")?

   There is no reasonable way to attack this problem except by searching the Internet for web sites that already know the answer. Just sitting down and trying to think up the answer is very unlikely to bear fruit. If you keep this question stashed in the back of your mind, you might someday stumble across *bookkeeper* and shout, "Eureka!" But if you consider questions like this to be *puzzles*, you're likely to be frustrated and not get a good mental exercise.

2. **A puzzle should be fair.** I use the term "tight" to refer to a puzzle that has a single answer that no one would debate. Some good, valid puzzles aren't 100% tight, but they should always be fair. The solver must have a fighting chance of success. I once read about a sequence "puzzle" that asked the solver to name the next number in a sequence. The sequence had a series of increasing numbers but no obvious pattern. The author said that the sequence represented street numbers of stations on a particular subway line in New York City. This question is unfair for about 99.999999% of the world's population. I'll try to avoid non-puzzles like this.

3. **A puzzle should be more work for the creator to create** than it is for the solver to solve. If an author uses a computer or a formula to generate puzzles, he should at least throw out the ones that aren't fun to solve. I expect the designer to add wit and intelligence to his creation. A brilliantly crafted puzzle is a thing of beauty, worthy of your mental gymnastics.

4. **The best puzzles have an "Aha!" moment.** When your brain performs that seemingly miraculous feat of putting all the pieces together, you feel a rush. A moment before, you may have been confused. But all at once the light bulb comes on and you have the answer. I hope to give you some of those precious moments as we exercise our brains.

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Loyd, Sam. Cyclopedia of Puzzles. New York, Lamb Publishing, 1914. (see www.mathpuzzle.com/loyd for full text)

Brecher, Edwin. The Ultimate Book of Puzzles, Mathematical Diversions, and Brainteasers. New York, St. Martin's Griffin, 1996.

Borgmann, Dimitri. Language on Vacation. New York, Scribner, 1965.

Pink, Daniel. A Whole New Mind. New York, Riverhead, 2005.

Some Noteworthy Web Sites

www.google.com – where to start looking for anything on the web

en.wikipedia.org– a wonderful, user-maintained encyclopedia and reference source (Wikipedia)

www.gutenberg.org – Project Gutenburg (USA) has complete texts of many public domain books

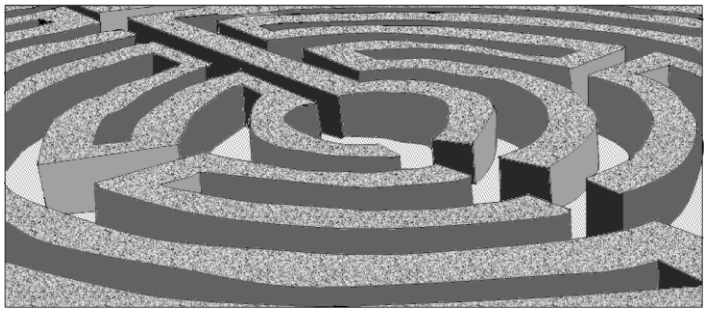
www.thefreedictionary.com – a great dictionary and thesaurus

www.dmoz.org/Games/Puzzles – dmoz open directory project is a gateway to worlds of great puzzles

www.lexfn.com – Lexical FreeNet connected thesaurus, a word association tool

www.rhymezone.com – RhymeZone, rhyming dictionary, etc.

www.braintrainerpuzzles.com – William Armstrong's companion web site for this book.



Chapter 1 – Mazes

As I said in the Orientation, you can skip the following story if you want to go straight to the puzzles. The story is presented as a humorous introduction to mazes. It is intended to show that mazes have fascinated mankind for millennia.

Story

King Minos should not be confused with King Midas who died as a result of severe gilt feelings and too limited a diet (he was only allowed 24 carats a day). Minos, on the other hand, was Greek mythology's ruler of Crete. Now it turns out that a fugitive wise man named Daedalus had found his way into Minos's employ after slipping through an Athenian dragnet like a Greeced pig. The clever architect and inventor had impulsively pushed his promising pupil, Talos, a little too hard (over a cliff) and decided that the local Board of Education would frown on such an action.

King Minos, however, was delighted to offer Daedalus asylum in exchange for a little favor. Minos commissioned the architect to build a house for the king's pet monster, a beast who was half man and half bull. Perhaps a little more than half bull, if you ask me. Nevertheless Daedalus constructed a maze of corridors which (like the story) seemed to lead nowhere. The bewildering building became known as the Labyrinth, the prison home of the monstrous Minotaur. It was hopeless to attempt escape from the brilliantly designed maze. Even so, the Minotaur had no desire to leave the Labyrinth; human sacrifices wandered the endless passages until the resident beast decided it was dinnertime.

Finally, a Greek youth named Theseus decided to put an end to the Minotaur in the maze. Although the designer of the Labyrinth had

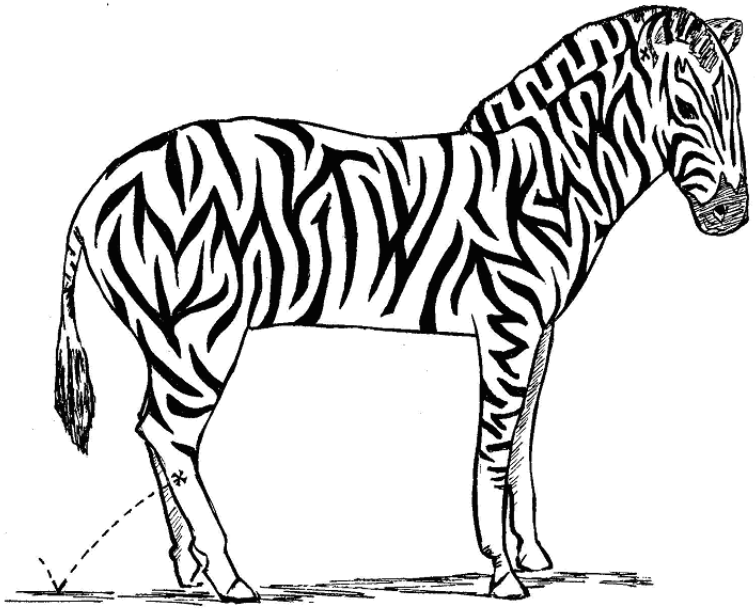
already flown the coop (or whatever it was they flew in those days), Theseus was able to enlist the help of Minos's daughter, Ariadne. Confident of the young man's ability to slay the evil Minotaur, Ariadne devised a method for her hero to escape the complicated hallways after accomplishing his dark deed. She gave Theseus a ball of thread to unwind as he entered the maze (even heroes like to unwind before a battle). The plan worked perfectly; the Minotaur's reign of terror was ended; and Theseus followed the thread to his sweetheart.

Warm-Up Exercises

Puzzle answers begin on page 187

Let's jump right into a puzzle.

1. ...Whose Fleas Were White As Snow



Help the albino tsetse fly walk from the zebra's hind leg (X) to its ear (another X) while staying only on the white areas.

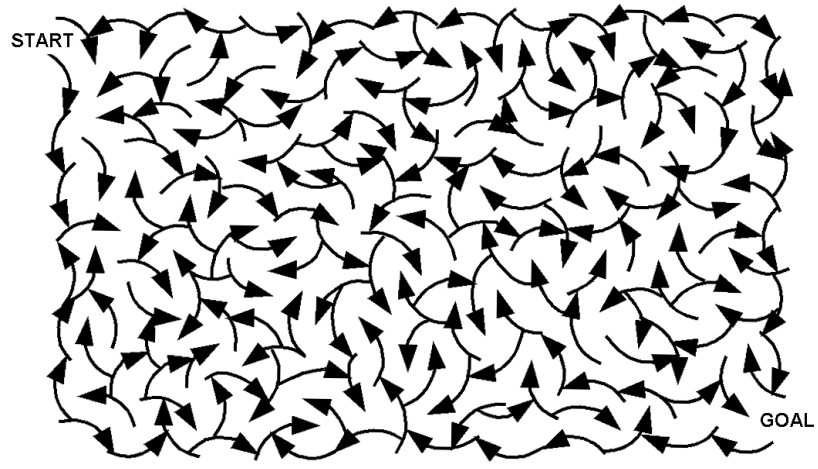
You solved this simple example using your right-brain functions. The correct route took you to the base of the zebra's tail, down to the belly, and into the right foreleg and mane.

What Is a Maze?

Basically, a maze is a confused and twisting complex of corridors. It may be drawn out on a flat surface as a diagram seen from a bird's-eye view; or it may be constructed in three dimensions for a castle courtyard. Most often the serpentine passageways allow a choice of turns at several points. Mazes are usually designed with an entrance and an exit (sometimes the same door), although the goal may lie deep inside.

Mazes are visual puzzles that contain visual traps. They often provide images that draw your eye away from the correct path. The next example contains a confusion of arrows forming the walls of the maze. The arrowheads exist only to distract you from your course. They try to entice your subconscious mind to stray in the wrong direction.

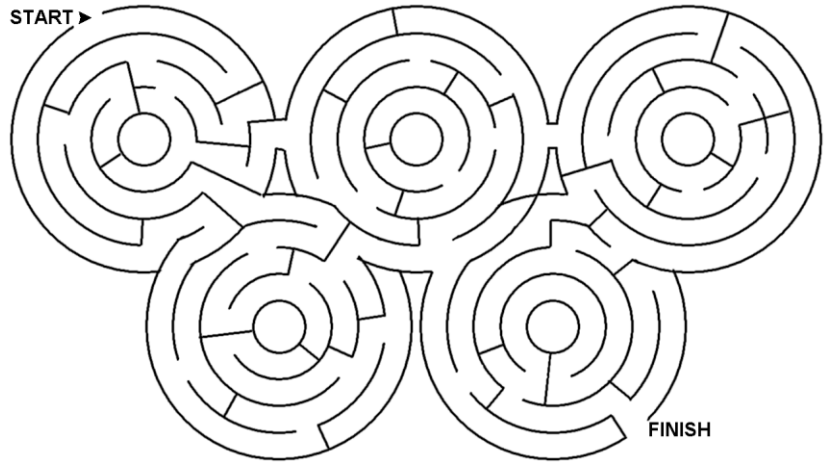
2. An Arrow Escape



The answer (at the back of the book) not only maps a path through the maze but also shows you what the maze looks like without the arrowheads. Notice that the correct path has you fighting the arrowheads at most of the decision points. This brings us to our first maze-solving tip.

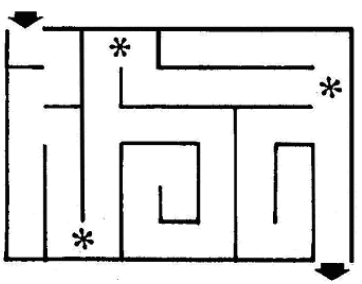
> **Maze Solving Tip #1** – Try to **ignore unnecessary distractions** that can nudge you off course. A drawing that leads your eye in a certain direction is usually a trap.

3. Olympic Targets



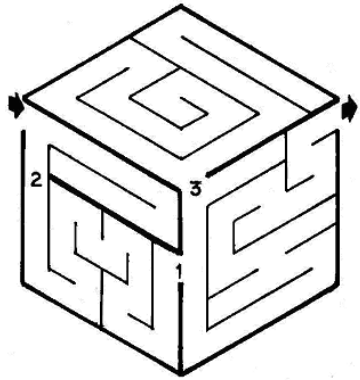
One technique that most successful maze solvers use is ***blocking***. With a bird's-eye view of the maze, the solver looks for major boundary lines within the overall borders.

> **Maze Solving Tip #2** – Try to break a maze into **blocks** that must be crossed or that may be quickly eliminated. Use your right-brain skills to look at the maze as a whole and identify unbroken lines that are boundaries of blocks.



> **BLOCKING** – The solver looks for key points (marked with ∗ on the illustration) that are gaps between obvious visual blocks.

For example, consider the block-shaped puzzle on the next page; the goal is to enter the diagram at the left arrow and exit at the right. The numbers and heavy lines are only included to make the following description easier.



A MENTAL BLOCK

Observation 1: The opening at position 1 is the only exit from the block's left face. Noting this fact, we can use analysis to break the problem into two simpler mazes. First we go from the entrance to position 1 and then from position 1 to the exit.

Observation 2: To reach position 1 from the entrance we must pass position 2. You can see this at a glance because the straight line between these two points (drawn more heavily for illustration purposes) prevents any other path. The line essentially separates the "face" into two sections, connected by a single bridge at position 2. Even if you do not notice this kind of blocking immediately, by the time you reach a dead end the condition should become obvious.

Observation 3: Because the opening at position 3 is the only connection between the puzzle's upper face and the rest of the maze, we can conclude that the entire upper face must be a dead end. We may ignore the upper face without examining ***any*** of its detail. You can save time and effort when large areas of the puzzle can be eliminated in this manner.

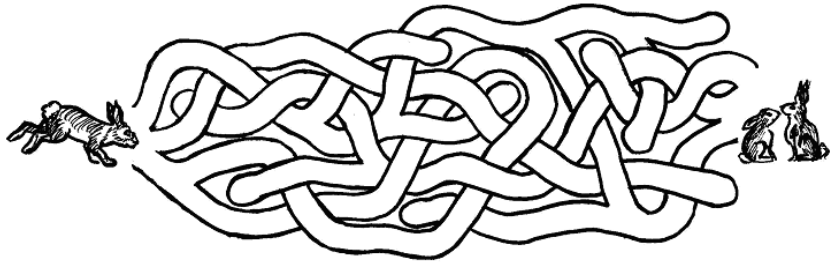
This "blocking" technique encourages you to:

1. Look for areas with only one entry point. These are ***blinds***, or dead ends.
2. Look for areas with only one exit point (other than the entrance). These sections of the maze must be crossed because you must reach the exit point.
3. Analyze (or break down) the puzzle into smaller, more workable mazes.

How do maze designers try to prevent you from seeing blocks? One way is by avoiding straight lines as we saw in the Olympic Targets puzzle. Another technique is to create "weave" mazes where the paths cross over each other like freeway overpasses.

4. Watership Down and Back

Hare-iette, a Welsh rabbit, is leaving Warren, her husband. She has two more of her little babies to escort out through the underground tunnels. Help her travel to the babies through this "weave" (three-dimensional) maze. Paths that appear to pass under each other can be used to cross, but not turn at other paths.



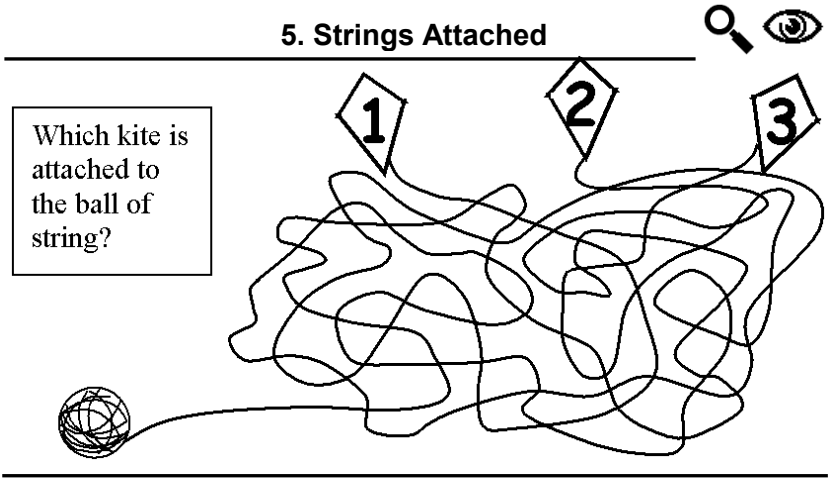
Weave mazes discourage blocking by crossing over their own paths. They force you to think in three dimensions and to look for other approaches to solving them.

> **Maze Solving Tip #3** – **Work backward** from the goal as well as forward from the start. This divides the puzzle into two smaller problems. Working back from the goal usually has fewer traps and dead ends, as well.

How does a maze designer discourage us from solving in the reverse direction? One way is by making it hard to know where the goal lies. A common puzzle for children might ask, "Which kite is attached to which string?"

By offering three possible ending locations, the designer eliminates any advantage to working backwards.

5. Strings Attached



The Best Maze Tip

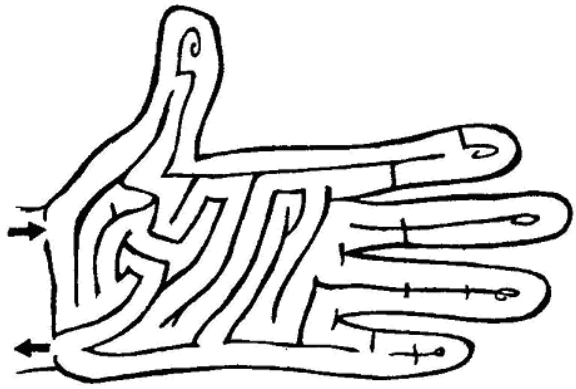
So far, all of the puzzles have been very simple for three reasons:

1. Easy puzzles build confidence. I don't want anyone getting discouraged.
2. Simple mazes help to illustrate the basic solving tips.
3. Most adults these days don't get much right-brain exercise; I wanted to ease into it.

By the time children reach the first grade, we direct most of their formal education toward left-brain activities: verbal skills, math, logic, etc. Mazes provide right-brain exercise, particularly when we allow our visual thinking to solve the maze as a whole. Before you get involved in the details, always look at the entire maze and let your intuition suggest the proper path. You can actually improve your right-brain thinking with practice.

For folks like me who spend most days in their left brain, I now offer a general rule that can help you find your way through almost any maze.

> **Maze Solving Tip #4** – Imagine that your **left hand** can never leave the wall to your left. Always traveling with your hand against the wall will get you to an exit of the maze.



THE LEFT HAND RULE.

Consider the hand-shaped puzzle above as an example. Its entrance is at the upper wrist, and its exit is at the lower wrist. The Left Hand Rule sends you into the thumb, to the index finger, back to the thumb, into the palm, and finally through each of the remaining fingers to the exit. Notice that although the rule diligently directs us from entrance to exit, the path that it traces is not the shortest possible route. At the second decision point (the knuckle of the thumb) we are sent to the left on a needless side trip into the index finger. When we return from the dead end, the rule directs us left along the proper path into the palm.

Hand and Eye-land Coordination

Now that we have a simple, foolproof method for attacking mazes, let's see what's wrong with it. The Left Hand Rule will almost never give us the shortest path. Dead ends and double-backs mar almost any attempt to apply the rule. Another disadvantage is that the rule must be applied continuously from the entrance to the exit; you cannot deviate from the indicated path and later resume the rule expecting it to bring you back to an outside door. This means that shortcuts cannot be safely taken.

The biggest disadvantage of the Left Hand Rule is the problem of ***islands***. If the object of a maze is to get to the center rather than to the "other side," then the rule may not work. For example, the goal of the eye-shaped puzzle on the next page is to travel from the arrow to the star at the center.

But applying the Left Hand Rule is fruitless. It takes the solver on a circular trip around the perimeter of the eye's iris but does not begin to probe the center. The rule has failed us.

NOTICE that applying the Left Hand Rule proves fruitless in this case.

Even if we begin applying the rule on the first circle in from the outermost edge, we wind up on a hopeless loop that reaches neither the center nor the outside. The walls that surround the central star form an island within the maze that is not connected in any way to the outer walls. With no walls connecting the outside to the center, a maze with islands thwarts our Left Hand Rule.

> **Maze Solving Tip #5** – Be prepared to abandon the 'hand' rule when the goal lies within an **island**. Use your blocking skills to recognize where you need to cross over to an island.

One of the five solving tips we've seen can be applied to almost any kind of puzzle, so here it is as a general puzzle principle.

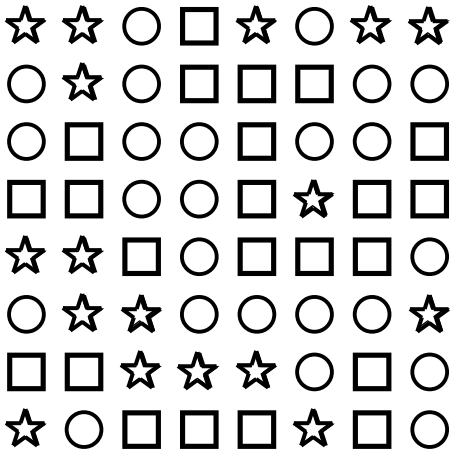
Ignore distractions. Puzzle designers will try to mislead you and direct your attention away from the primary goal. Fight to stay focused on the main puzzle. Try to recognize the red herrings (irrelevant details) and look elsewhere for the answer.

With these tips understood, we should be ready to begin a more vigorous workout.

Moderate Workout

We can make our mazes harder by forcing the solver to create the maze in his mind. Conceptual mazes exercise your left-brain functions and prevent you from seeing blocks. Try this one:

6. Symbolism



Here is a small, simple maze that packs a punch. The object is to travel between the symbols from one edge of the diagram to another. It is up to you to decide which edge (top, right, bottom, or left) to enter and which edge to exit. There are two rules.

1. You must move up-and-down or right-and-left, never diagonally.
2. You must always move in the spaces between two identical symbols (two squares, two stars, or two circles).

For example, you can enter the bottom edge between the two squares at the center of the bottom row. You can't go right or left from there; both directions have a star and a square lining the path. But you can continue up between the two stars.

Maze Solving Tip #6 – Draw a **diagram** to simplify a complex puzzle and help you use your visual skills to solve it. If you can "see" the diagram in your mind without actually drawing it, you will have an even more powerful tool.