

# Two Washers Mind Puzzle

**Category:** Mathematics: Puzzles

**Type:** Make & Take

## Rough Parts List:

6"	Wood block, 1" x 2"
3'	Rope, fat , 3/16" flexible chord works well
Small	Drill bit, just bigger than string
1/2"	Drill bit, much bigger than string
2	Washers, 3/8"
	Tape, masking or electrical
	Hot glue gun



**Video:** <http://youtu.be/zHwDuii-xL8>

## How To:



Drill a hole at each end of the wood block using a small drill bit.



Drill a hole in the center of the block using the big drill bit.



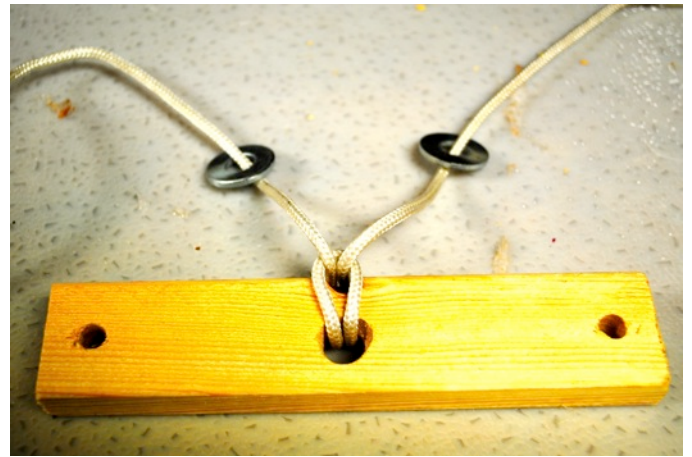
Wrap tape around the 2 rope ends.



Fold the rope in half and push the center through the middle hole.



Push the 2 rope ends through the center loop.



String a washer onto each free end of rope.



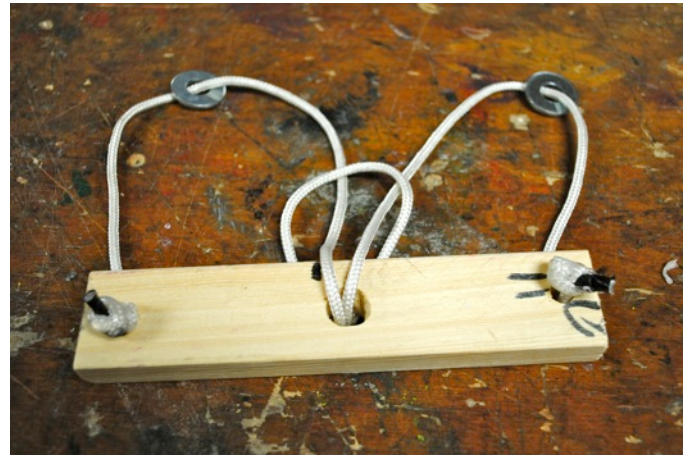
Push 1 loose rope end into a side hole and knot the rope so it cannot slip out.



Cut off the taped piece of rope.



Use a glue gun secure the knot.



At first, your puzzle will have 1 washer on each side of rope.



Without untying any knots, manipulate the rope to move both washers onto the same side.

### Fine Points:

- Many people will give up, but before the answer is given, some hints can be given (not even the hints should be made known until there has been some playing around):
- There is a reason for the bigger hole in the center.
  - The washer doesn't fit through the center hole, but the knot can.

### Concepts Involved:

- Shapes and patterns
- Topology

### Focus Questions:

1. Could you make a string puzzle that could not be solved?

2. If you had four holes in the wood of this project, and two knots in the center holes, could you get the washers from one side to the other?

### **Elaboration:**

This string puzzles is about topology, an interesting field of mathematics that is concerned with shapes in many dimensions, and how they change as you manipulate them. A string is an example of a one-dimensional object; you can go back and forth in only one direction: up the string or down the string. Paper is a two-dimensional object and a box is a three dimensional object. To remove the loop or move the washers from one side to another, you have to consider the topology of the entire system.

There are plenty of arrangements with strings that can't be solved. If you tied your shoes and glued the shoe string laces together, it would be impossible to get the knot out of the string. But if you put another hole in the center of the Two Washers puzzle and put the string through it the same as the center hole, you could move the washers back and forth in the same way.

### **Links to k-12 CA Content Standards:**

#### Grades k-8 Standard Set Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

#### Grades k-12 Mathematical Reasoning:

1.0 Students make decisions about how to approach problems:

- 1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
- 1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:

- 2.1 Use estimation to verify the reasonableness of calculated results.
- 2.2 Apply strategies and results from simpler problems to more complex problems.
- 2.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
- 2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:

- 3.1 Evaluate the reasonableness of the solution in the context of the original situation.
- 3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
- 3.3 Develop generalizations of the results obtained and apply them in other circumstances.