

**Figure 11.1** A Sudoku Puzzle

	8				2			
			7	3	9		2	
9		7				3		5
	4	2	1	9		6		
1		5				9		4
		9		8	4	5	1	
2		6				7		8
	9		8	7	1			
			5				3	

Try to fill in the empty cells with numbers from 1 to 9. Each three-by-three box, each row, and each column may not have any repeated numbers (each may only have the numbers 1 to 9 in them).

# Figure 11.2 Pennies Problem: Is There a Way to Move Two Pennies Such That All of the Pennies Touch Three and Only Three Other Pennies?

(a)



(b)



# Figure 11.3 Solution to the Pennies Problem

(a)

## Initial states



(b)



## Potential moves

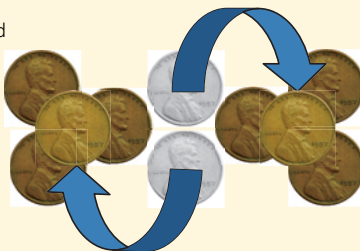
There are no locations where the moved penny touches three other pennies

There are some locations where the moved penny touches three other pennies, but these locations do not result in all of the pennies touching three pennies

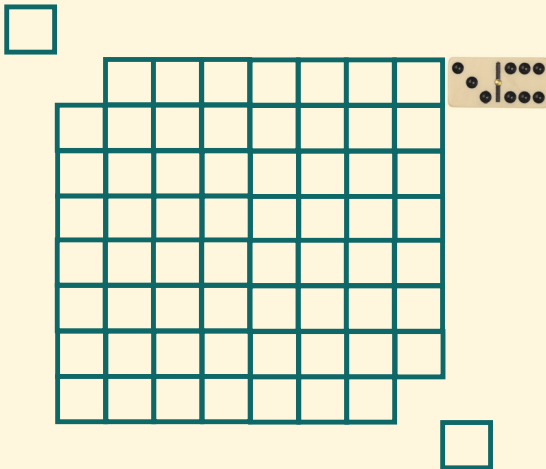


## Solution

The solution is that the moved pennies may be stacked on top of the other pennies.

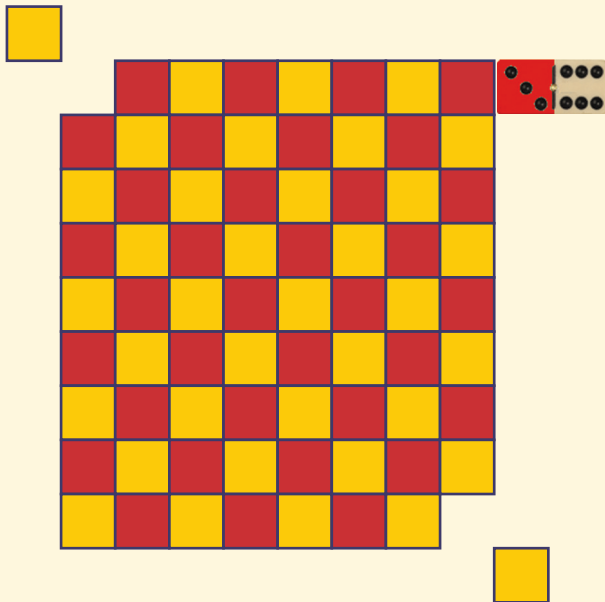


## Figure 11.4 Domino and Distorted-Checkerboard Problem

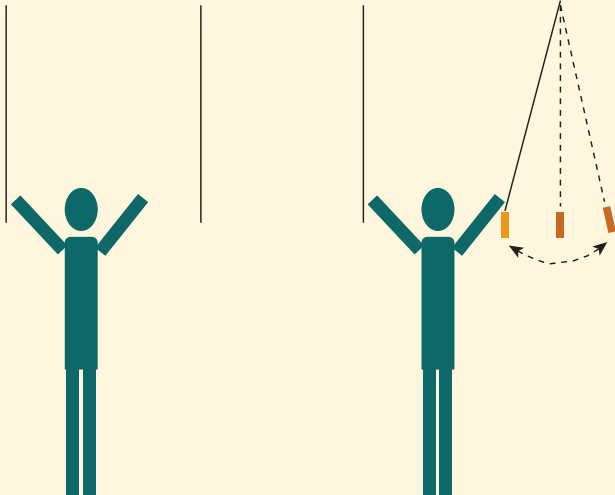


Imagine that you have a checkerboard with two diagonal corner squares removed. Can you place dominos that cover two squares each and completely cover the checkerboard?

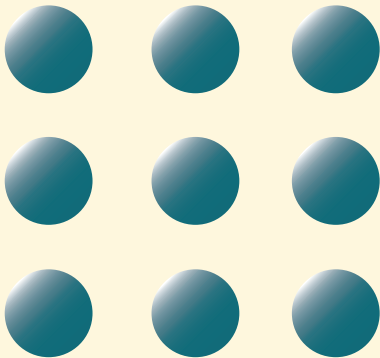
**Figure 11.5** Variation of the Distorted-Checkerboard Problem



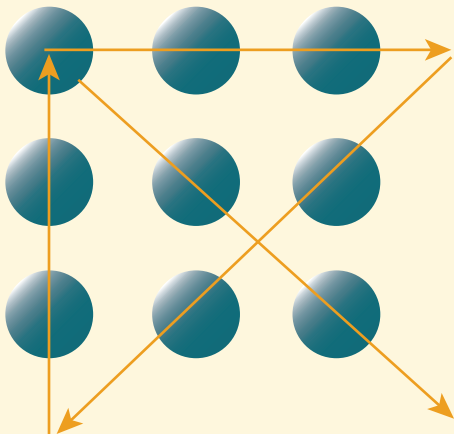
**Figure 11.6** The Two String Problem



**Figure 11.7** The Nine-Dot Problem:  
Connect the Dots With  
Four Straight Lines



# Figure 11.8 The Nine-Dot Solution: The Key Is to Represent the Problem Without Borders



Begin at top left dot and follow the arrows.



## Figure 11.9 The Tower of Hanoi

Problem: How can you move the discs to go from the initial state to the goal state?

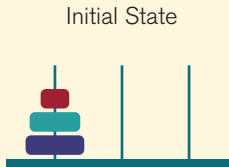
Initial State



Goal State



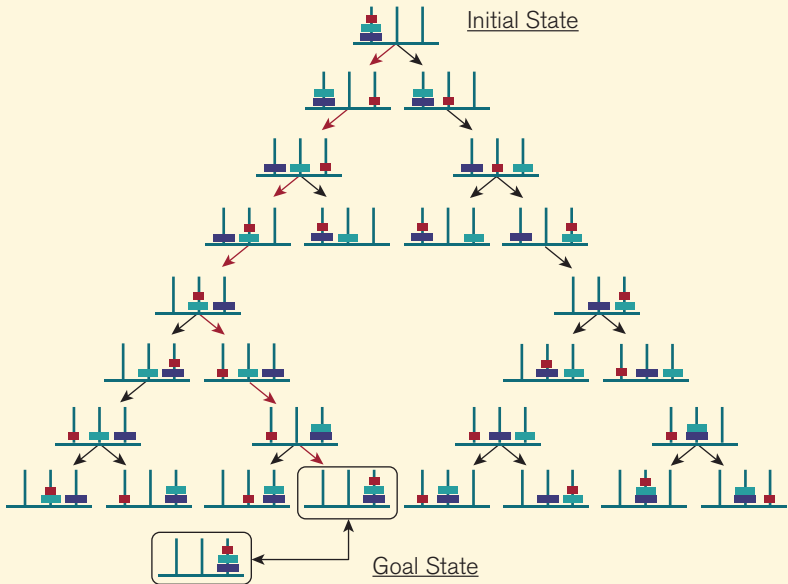
## Figure 11.10 The Problem Space for the First Move of the Tower of Hanoi Puzzle



Operator: You may move one disc at a time, but only onto either an empty space or a larger disc.

Sub-goals: Need to move the purple disc. To move the purple disc, need to remove the green disc. To move the green disc, need to move the red disc.

# Figure 11.11 Some of the Problem Space for the Tower of Hanoi Puzzle



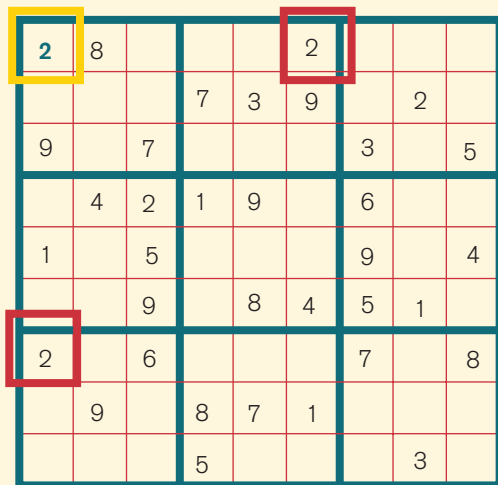
Figure

11.12

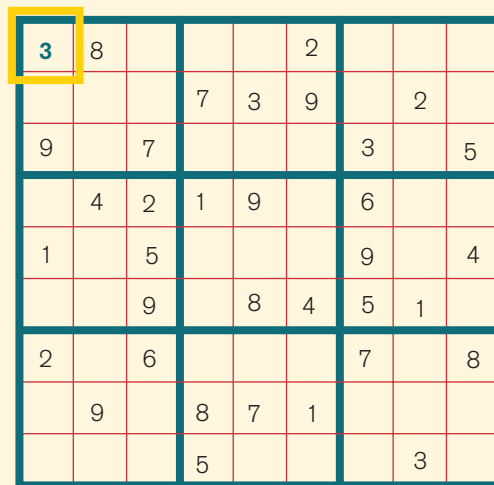
## Potential Solutions in the Problem Space of the Sudoku Puzzle Given in Figure 11.1

Potential solutions in the problem space of the Sudoku puzzle given in Figure 11.1. The yellow box indicates a possible locations for a potential solution number. The red boxes indicate reasons that rule out that possible solution.

(a) Attempting a 2 in the upper-left space

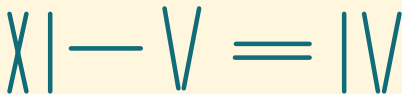


(b) Attempting a 3 in the upper-left space

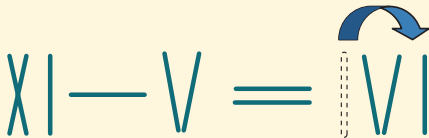


# Figure 11.13 Matchstick Problem and Solution

## Problems



## Solution



# Figure 11.14 Matchstick Problems

## Problems

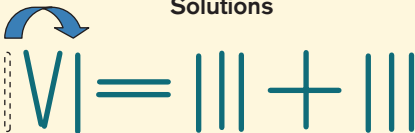
(a)  $IV = III + III$

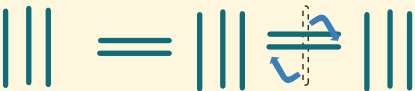
(b)  $III = III + III$

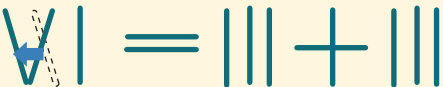
(c)  $XI = III + III$

# Figure 11.15 Solutions to Matchstick Problems

## Solutions

(a) 

(b) 

(c) 

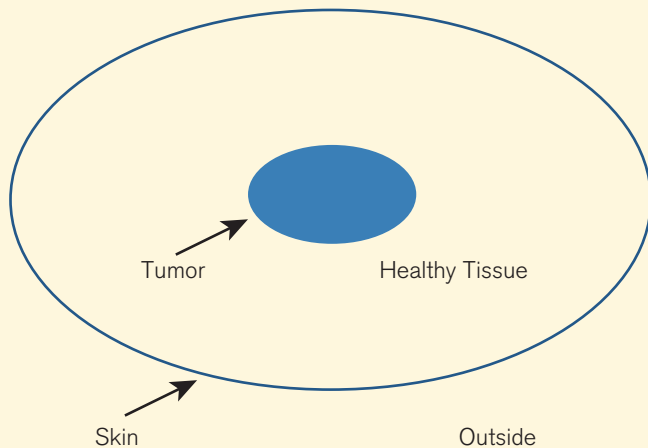
(a) Move first stick to follow the V, (b) rotate one of the sticks of the plus sign to create an equals sign, (c) shift the down slanting stick over to create a V.

**Figure 11.16** Sudoku Solution From Figure 11.1

3	8	1	6	5	2	4	9	7
6	5	4	7	3	9	8	2	1
9	2	7	4	1	8	3	6	5
8	4	2	1	9	5	6	7	3
1	3	5	2	6	7	9	8	4
7	6	9	3	8	4	5	1	2
2	1	6	9	4	3	7	5	8
5	9	3	8	7	1	2	4	6
4	7	8	5	2	6	1	3	9

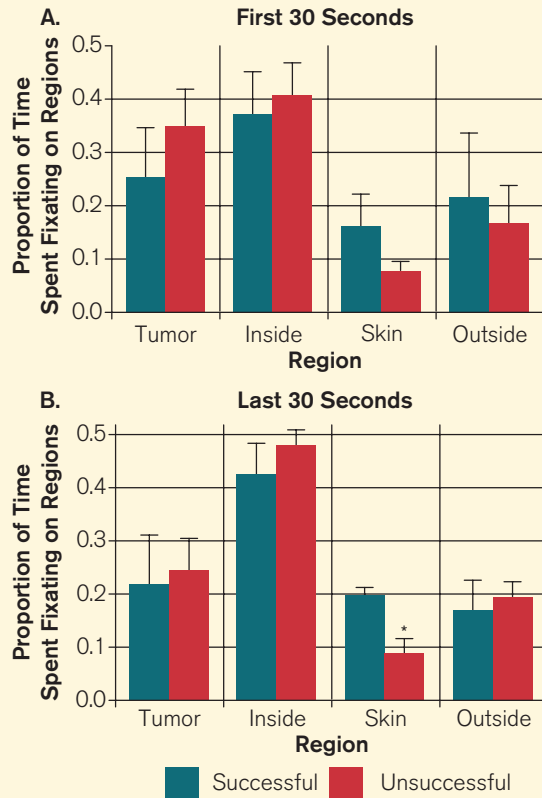


**Figure 11.17** Diagram Shown to Subjects in the Grant and Spivey (2003) Study



SOURCE: Figure 1, Grant, E. R., & Spivey, M. J. (2003). Eye movements and problem solving: Guiding attention guides thought. *Psychological Science*, 14(5), 462–466.

## Figure 11.18 Results From Grant and Spivey's (2003) Experiment 1



SOURCE: Figure 2, Grant, E. R., & Spivey, M. J. (2003). Eye movements and problem solving: Guiding attention guides thought. *Psychological Science*, 14(5), 462–466.

**Table 11.1** Structural Similarities Between the Radiation and Army Problems

	RADIATION PROBLEM	ATTACKING ARMY PROBLEM
Problem statement	<p>Doctor has radiation beams.</p> <p>Patient has a tumor.</p> <p>Tumor is surrounded by healthy tissue.</p>	<p>General has an army.</p> <p>Country has a dictator.</p> <p>Dictator is living in a fortress sitting at the center of country surrounded by villages.</p>
Desired goal	Destroy the tumor with beams.	Capture the fortress with army.
Problem constraints	<p>High-intensity beams destroy tumor and healthy tissue.</p> <p>Low-intensity beams don't destroy tumor or harm healthy tissue.</p>	<p>Entire army can capture fortress, but large group detonates mines on road destroying army and villages.</p> <p>Small groups of men can safely pass over roads but cannot capture the fortress.</p>
Solution	Use several low-intensity beams from different directions that converge on the tumor and destroy it.	Separate the army into smaller groups of men. Send each group down separate roads and attack the fortress simultaneously.
Goal state	<p>Tumor is destroyed.</p> <p>Healthy tissue is unharmed.</p>	<p>Fortress is captured.</p> <p>Army and surrounding villages are intact.</p>

SOURCE: Adapted from Gick, M. L., & Holyoak, K. J. (1980). Analogical problem solving. *Cognitive Psychology*, 12, 306–355.

Table

11.2

Grant and Spivey's (2003) Study Results

CONDITION	SUCCESSFUL	UNSUCCESSFUL	<i>n</i>
Static (Experiment 1 )	36% (5)	64% (9)	14
Static (Experiment 2)	37% (10)	63% (17)	27
Animated tumor	33% (9)	67% (18)	27
Animated skin	67% (18)	33% (9)	27

SOURCE: Table 1, Grant, E. R., & Spivey, M. J. (2003). Eye movements and problem solving: Guiding attention guides thought. *Psychological Science*, 14(5), 462–466.