Goals:

- We will look at logic puzzles and attempt to formalize the process of applying logic to solve puzzles using deductive reasoning.

Coerced conclusions:
I think I can make **most** people think of the same thing, by simply involving them in some coerced logic:

You will be asked to simply perform a set of tasks, you may want to use a calculator to check your arithmetic.

1) Everyone present, **silently** pick a small number, but do not reveal your number.
2) Double your number.
3) Add eight to the result
4) Divide the result by 2
5) Subtract the original number.
6) Convert this into a letter of the alphabet.

$A = 1$, $B = 2$, $C = 3$, $D = 4$, $E = 5$, $F = 6$, $G = 7$, $H = 8$, $I = 9$, $J = 10$
$K = 11$, $L = 12$, $M = 13$, $N = 14$, $O = 15$, $P = 16$, $Q = 17$, $R = 18$, $S = 19$
$T = 20$, $U = 21$, $V = 22$, $W = 23$, $X = 24$, $Y = 25$, $Z = 26$

Now
Think of the name of a country which starts with this letter.
Now
Think of an animal whose name starts with the country's second letter.
Now
Think of the color of that animal.

Conditional Statements applied to logic puzzles

Also recall that a **conditional statement** is a compound statement that uses the connective, "if…then…"

Deductive Reasoning is the logical adherence to a conclusion of a conditional statement whenever the hypothesis is true. In other words, given a conditional statement $p \to q$, q is True whenever p is True. Or the truth of p necessitates the truth of q.

Let us apply this to the logic puzzle:
Four children (Bob, Ken, Mary, Sue) each own one pet (Bird, Cat, Dog, Fish).

1) A boy owns the dog
2) Sue has a pet with 2 legs
3) Mary and Ken have never owned a fish

There are logical implications implied in each of the three statements.

1) If a boy owns the dog, then ____

2) If Sue has a pet with 2 legs, then ____

3) If Mary and Ken do not have a Fish, then ____

These statements can also be combined in meaningful ways using conjuncitons:
1 & 3: If a boy owns the dog AND Ken does not have a fish,
then ___________________________

It can be hard to keep track of all of these statements and their logical implications, so often times it is helpful to formalize the process of logical deduction using a table and some symbols: x= False, *=True (or any other symbols you prefer to represent the binary nature of each statement)

	Bird	Cat	Dog	Fish
Bob				
Ken				
Mary				
Sue				

1) A boy owns the dog
2) Sue has a pet with 2 legs
3) Mary and Ken have never owned a fish

See end of doc. for Solutions

Addition Squares: Some of the numbers are missing. The sum of any row is given. Find the missing numbers.

Puzzle 1

				//	12
1		4	5	=	13
	2	1		=	12
3		3	1	=	11
2	5			=	16
=	=	=	=	\\	
12	14	10	16		13

Puzzle 2

				//	11
	12	7		=	24
3	5	5		=	14
				=	23
2		6	5	=	17
=	=	=	=	\\	
17	22	26	13		20

See end of document for solutions.

Sudoku and other logic puzzles

The Rules of Sudoku

1. Each row, column, and nonet can contain each number (typically 1 to 9) exactly once.
2. The sum of all numbers in any square (of nine boxes), row, or column must match the small number printed in its corner. For traditional **Sudoku** puzzles featuring the numbers 1 to 9, this sum is equal to 45. This results in each row, column and square containing every number from 1 to 9 (noting that 1+2+3+4+5+6+7+8+9=45)

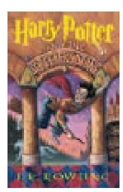
			6	4				7
			9	7	1		3	2
1			2		3	5		
5	1			6		7	9	8
			5		9			
9	6	4		3			2	5
		1	8		6			4
3	5		1	9	4			
6				5	7			

For tips on solving Sudoku puzzles you can follow the link here or simply the internet search for "Solving Sudoku Tips"

For the solutions, see the end of the notes:

Harry Potter and the Sorcerer's Stone: Snapes Puzzle

In *Harry Potter and the Sorcerer's Stone*, a novel by J. K. Rowling, Harry Potter and Hermione Granger are trapped in a room with only two exits, both blocked by flames. On a table in the room are seven differently shaped bottles along with the following clues on a roll of paper:



Danger lies before you, while safety lies behind,
Two of us will help you, whichever you would find,
One among us seven will let you move ahead,
Another will transport the drinker back instead,
Three of us are killers, waiting hidden in line.
Choose, unless you wish to stay here forevermore,
To help you in your choice, we give you these clues four:
First, however slyly the poison tries to hide
You will always find some on nettle wine's left side;
Second, different are those who stand at either end,
But if you would move onward, neither is your friend;
Third, as you see clearly, all are different size,
Neither dwarf nor giant holds death in their insides;
Fourth, the second left and second on the right
Are twins once you taste them, thought different at first sight.

(*Harry Potter and the Sorcerer's Stone*, Rowling, 1998, p. 285)

Hermione realizes that logical reasoning is needed to determine which bottles will lead to their escape. She states: "This isn't magic – it's logic – a puzzle. A lot of the great wizards haven't got an ounce of logic, they'd be stuck in here forever." Hermione determines which bottles lead to their escape. She returns through the purple flame to assist Ron and get help while Harry goes forward through the black flame toward the Stone and the villain. From which bottles did each drink?

	1	2(giant)	3(dwarf)	4	5	6	7
NW x 2							
P x 3							
F							
B							

Clues:

1: P is always on left of NW $\rightarrow P \neq 7$

2: 1≠7 AND (1≠F AND F≠7)

3: $2 \neq P$ AND $3 \neq P$ $\rightarrow 3 \neq NW$ AND $4 \neq NW$

4: $2 = 6$ $\rightarrow$ *if* $2 \neq P$ *then* $6 \neq P$

$\rightarrow$ *if* (only NW AND P have two or more of the same thing), then $2 = NW = 6$

$\rightarrow 1 = P$ AND $5 = P$

Fill in the table above and finish the logic puzzle. See end of document for solutions.

Logic Puzzle Solutions:

It can be hard to keep track of all of these statements and their logical implications, so often times it is helpful to formalize the process of logical deduction using a table and some symbols: x= False, *=True (or any other symbols you prefer to represent the binary nature of each statement)

	Bird	Cat	Dog	Fish
Bob	X			
Ken	X			X
Mary	X		X	X
Sue	T		X	

1) A boy owns the dog 1,
2) Sue has a pet with 2 legs 2,
3) Mary and Ken have never owned a fish 3.

Now we now Mary must have the CAT. So all other boxes for the cat are X'd out.
Which now means Ken has only one pet he could own, the DOG.
Therefore, the dog gets an X for BOB, which leaves BOB with only one free spot, the FISH

Addition Squares:

Puzzle 1

				⫽	12
1	3	4	5	=	13
6	2	1	3	=	12
3	4	3	1	=	11
2	5	2	7	=	16
=	=	=	=	⫽	
12	14	10	16		13

Puzzle 2

				⫽	11
2	12	7	3	=	24
3	5	5	1	=	14
10	1	8	4	=	23
2	4	6	5	=	17
=	=	=	=	⫽	
17	22	26	13		20

Sudoku Solutions:

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

	1	2(giant)	3(dwarf)	4	5	6	7
NW x 2	X	NW	X	X	X	NW	X
P x 3	P	X	X	P	P	X	X
F	X	X	F	X	X	X	X
B	X	X	X	X	X	X	B

Clues:

1: P is always on left of NW $\rightarrow P \neq 7$

2: 1≠7 AND (1≠F AND F≠7)

3: $2 \neq P \text{ AND } 3 \neq P$ $\rightarrow 3 \neq NW \text{ AND } 4 \neq NW$

4: $2 = 6$ $\rightarrow if\ 2 \neq P\ then\ 6 \neq P$

$\rightarrow if$ (only NW AND P have two or more of the same thing), then $2 = NW = 6$

$\rightarrow 1 = P \text{ AND } 5 = P$