

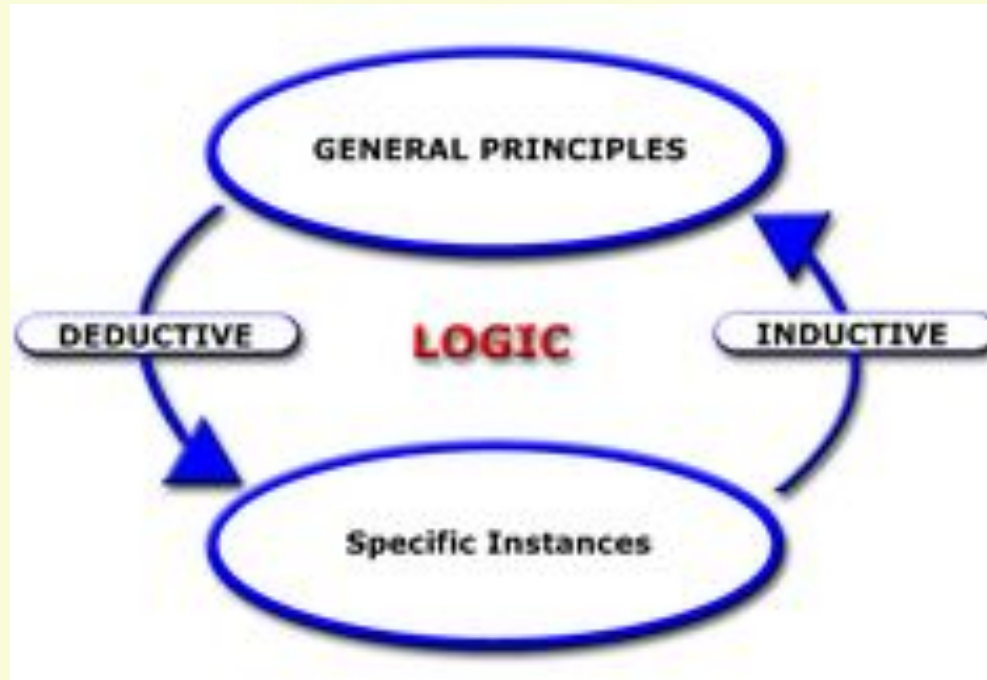
The background is a composite image. At the top, there is a world map with a grid overlay. Below the map, there are four test tubes containing a blue and red liquid, arranged diagonally. In the center, a microscope is visible. At the bottom, there is a grid of red circles. The overall color scheme is dominated by red and purple hues.

# Reasoning & Logic

*Forensic Science*

# Deductive & Inductive Reasoning

- Reasoning must use both **inductive** and **deductive reasoning**



# Deductive & Inductive Reasoning

- **Inductive and deductive** reasoning both strive to construct a valid argument.
- **Inductive** reasoning moves **from specific instances to a generalized conclusion**
- **Deductive** reasoning moves from **generalized principles to a specific conclusion.**

# Deductive & Inductive Reasoning

**Deductive reasoning** is using what you know to be true in general to decide what must be true in a specific case.

Its opposite is **inductive reasoning**: using observation of specific cases to reach a general principle.



# Deductive & Inductive Reasoning

## Examples of Inductive Reasoning

Here are a couple examples of inductive reasoning:

- You're a soccer player and you're tall, therefore all soccer players must be tall.
- All of my brothers are athletic, therefore all boys are athletic.

# Deductive & Inductive Reasoning

## Examples of Deductive Reasoning

Here is an example of deductive reasoning:

- All living things need water to survive.
  - Frogs are a living organism.
  - Therefore, frogs need water to survive.

# DEDUCTIVE REASONING

ALL ORANGES ARE FRUITS

ALL FRUITS GROW ON TREES

THEREFORE,

ALL ORANGES GROW ON TREES



A microscopic view of cells and test tubes, with a red and purple color scheme.

# Observation

- **Recall what we stated earlier about Observation:**

“Observation is anything that you can perceive with your senses and is the awareness of some condition.”



# Observation

- There are **two types** of observations
  - **Quantitative** – results in a numerical form, with a unit
  - **Qualitative** – results in a descriptive form



List FIVE observations regarding the cartoon above.

A microscopic view of cells and test tubes, with a red and purple color scheme.

# Logic Problems

**Logic Problems are great to use to  
learn how to use Deductive  
Reasoning!**

# How Do Logic Problems Work?

Logic puzzles use a grid to help keep track of your deductive reasoning as you read the clues. You use an "O" to show a match or something you know, and an "X" to show something you know doesn't go together. Let's take a look at how this works!

Let's use these clues to figure out what everyone's favorite fruit is!

## Clues:

- one of the girls likes blackberries the best.

We can assume that Patricia and Sallie are the only girls, so we need to put an "X" for each of the boys.

	apples	oranges	blackberries	mangos	watermelons
Brent			X		
Ryan			X		
Patricia					
John			X		
Sallie					

# How Do Logic Problems Work?

	apples	oranges	blackberries	mangos	watermelons
Brent		X	X		
Ryan		X	X	X	
Patricia		X			
John	X	O	X	X	X
Sallie		X			

2. Ryan doesn't care for mangos, and John loves oranges!

Here, we know to put an "X" for Ryan and mangos, and we need to put a "O" for John and oranges, which means we need to put "X"s for all the other fruits for John, and "X"s for all the other people in the orange column.

Every time you put a "O" you must fill the rest of that row AND column with "X"s! When doing a larger puzzle with multiple grids, only fill in the rows and columns in that small grid. There should be bold lines to show you where that small grid stops!

# How Do Logic Problems Work?

3. Sallie loves mangos, but Brent doesn't like watermelon.

Here, we need to put an "O" for Sallie and mangos, so we fill those rows and columns with "X"s. We need to put a "X" for Brent and watermelon.

	apples	oranges	blackberries	mangos	watermelons
Brent	O	X	X	X	X
Ryan	X	X	X	X	O
Patricia	X	X	O	X	X
John	X	O	X	X	X
Sallie	X	X	X	O	X

Now, that leaves Brent with only apples. That means we need to put a "O" there since that is the only possibility left!

Remember to fill in the columns and rows when you put a "O" anywhere!

But wait! Now Patricia is the only person left for blackberries, so put an "O" for her and blackberries, and fill that row in with "X"s.

Now we are left with only ONE place, Ryan and watermelon. So, we must put a "O" there since there are only "X"s in that row and column!



## **Let's Try a Simple Logic Problem**

I will hand out a logic problem for you and your partner to figure out.


Name: \_\_\_\_\_

# Zoo Trip Logic Puzzle

Xavier and his four friends are all in a group for the zoo field trip. Each student in the group was assigned a different animal to investigate and draw on the trip. Using the clues, can you figure out what animal each child is supposed to investigate?

## Clues:

1. one of the girls was So happy to have the King cobra!
2. Stephanie didn't have the tree frog, and Kim and Xavier helped the person with the penguin find their information.
3. Jennifer's giraffe drawing was great.
4. The boys had the frog and the penguin.
5. Two of the girls thought it was funny their animals started with the first letter of their names!



	Scarlet Macaw	King cobra	Gentoo Penguin	Tree frog	Masai Giraffe
Kim					
Jennifer					
Xavier					
Stephanie					
Greg					

\*Xavier and Greg are boys, the rest are girls!

Name: \_\_\_\_\_

# Musical Organization Logic Puzzle

Mrs. Dennis' music closet was getting very messy. She asked five students to each organize a certain type of musical instrument. Using the clues, can you figure out which instrument each student was in charge of?

## Clues:

1. Either Amy or Lucas organized the bongo drums.
2. Paul carefully stacked the xylophones.
3. one of the girls put away recorders.
4. Lucas was glad he didn't have to wash the kazoos.
5. Amy accidentally dropped a cow bell when putting them in the box.



	xylophones	recorders	Bongo drums	kazoos	cow bells
Sarah					
James					
Amy					
LUCAS					
Paul					

\*Sarah and Amy are girls, the rest are boys.





# Let's Try Another Logic Problem

# Deduction Logic Problem

**There are 5 houses in 5 different colors. In each house lives a person of a different nationality. The 5 owners drink a certain type of beverage, watches their favorite movie, and keep a certain pet. Using the clues on the next slide, can you determine who owns the fish?**

# The Logic Problem Grid

Nationality	Norwegian	American	Brit	German	Swede
Color					
Beverage					
Movie					
Pet					

- The Brit lives in a red house.
- The Swede has dogs as pets.
- The American drinks tea.
- The green house is on the immediate left of the white house.
- The green house owner drinks coffee.
- The person whose favorite movie is *The Avengers* raises birds.
- The owner of the yellow house loves the *Emoji Movie*.
- The man living in the house right in the middle drinks milk.
- The man who enjoys *Star Wars* lives next door to the one who keeps cats.
- The man who keeps horses lives next door to the man who loves the *Emoji Movie*.
- The owner whose favorite movie is *Jurassic Park* drinks soda.
- The German loves *Jumanji*.
- The Norwegian lives next to the blue house.
- The man who enjoys *Star Wars* has a neighbor who drinks only water.
- The Norwegian lives in the first house.

# The Solution

<b>Nationality</b>	<b>Norwegian</b>	<b>American</b>	<b>Brit</b>	<b>German</b>	<b>Swede</b>
<b>Color</b>	<b>Yellow</b>	<b>Blue</b>	<b>Red</b>	<b>Green</b>	<b>White</b>
<b>Beverage</b>	<b>Water</b>	<b>Tea</b>	<b>Milk</b>	<b>Coffee</b>	<b>Soda</b>
<b>Movie</b>	<b>Emoji Movie</b>	<b>Star Wars</b>	<b>Avengers</b>	<b>Jumanji</b>	<b>Jurassic Park</b>
<b>Pet</b>	<b>Cats</b>	<b>Horses</b>	<b>Birds</b>	<b>Fish</b>	<b>Dogs</b>



# Whodunit?

**A man is lying dead in the hospital morgue.  
The cause of his death is a mystery.**

**Why do you think he died?**

**Take a look at the following sets of clues.  
After each clue set, you need to discuss the clues with  
your table and fill in the correct question on your  
activity sheet.**

# Clue Set #1

## **Here's what the police know to be facts:**

- The victim once worked for his government as a spy.
- In recent years, he publicly criticized the government he once served.
- He became violently ill and was hospitalized.
- Medical personnel were unable to identify the cause of his illness.

## **On the day he became ill, he:**

- met with another former spy at a hotel where they drank tea.
- ate lunch at a restaurant with a person who claimed to have proof of crimes committed by this same government.
- met with his ex-girlfriend's new boyfriend in the hotel lobby.

**Three weeks later, the victim died in the hospital.**

# Clue Set #2

**It is now several weeks later. The police have additional facts. They now know the following:**

- The victim died from a rare form of radiation poisoning from the chemical polonium-210.
- Thirteen other people including eight hotel employees and two hotel guests tested positive for polonium-210 exposure.
- A teapot at the hotel tested positive for polonium-210 exposure.
- Traces of radiation were found at the victim's home, the restaurant, the hotel, and in other locations, including airplanes.



# Clue Set #3: Final Clue

**A final clue has surfaced!**

- The source of the polonium-210 has been traced to a nuclear facility in the homeland of the victim as well as the former spy he met for tea.

**Who do you think killed the man?**

**Discuss all three clue sets with your table and complete your activity sheet. Giving full answers to each of the questions.**

**Turn the sheet into the blue basket for classwork credit.**

# This was a true story...

- On 1 November 2006, Litvinenko suddenly fell ill and was hospitalised in what was established as a case of poisoning by radioactive polonium-210; he died from the poisoning on 23 November. He became the first known victim of lethal polonium 210-induced acute radiation syndrome.
- A British murder investigation pointed to Andrey Lugovoy, a former member spy and member of Russia's Federal Protective Service, as the prime suspect.
- British officials discovered a teapot at London's Millennium Hotel with an off-the-charts reading for polonium-210, the radioactive material used in the killing. Unfortunately, the teapot was used by the hotel staff later to serve tea to other customers. Those customers were also contaminated by the residual radiation left on the teapot.

# This was a true story...



*Alexander Litvinenko, aged 43 :  
Before and after effects of radiation poisoning with 'polonium - 210'.  
Reported feeling ill on 1 Nov. 2006, died 23 Nov. 2006.*