

# Science!

What is it?

# Science

- A way of learning about the natural world through observations, asking questions, proposing answers and testing those answers!
- It is our present understanding of the natural world and the processes that lead us there



# Characteristics of Science

- 1. Observations lead to questions
  - Why, Where, When, What, How????
  - Testing
  - Evidence!

# What is an observation?

- Something you can experience directly using your five senses



# Tools of Observation

- ❑ Microscope
- ❑ Telescope
- ❑ Chemical Indicators
- ❑ Can you think of any?



# Indirect Observation

## □ Inference

- Something you can not directly observe but can derive a tentative conclusion based on logic or reasoning

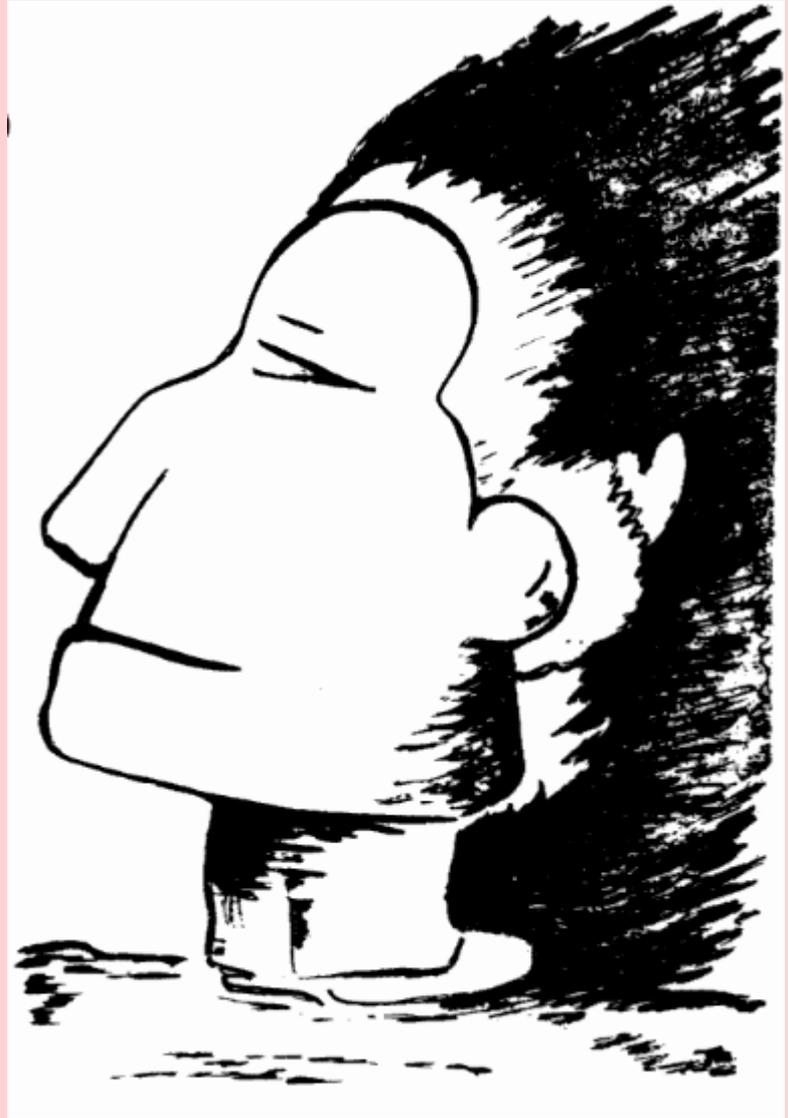
Is it possible that some scientists may look at the same piece of evidence or set of data and see different things?



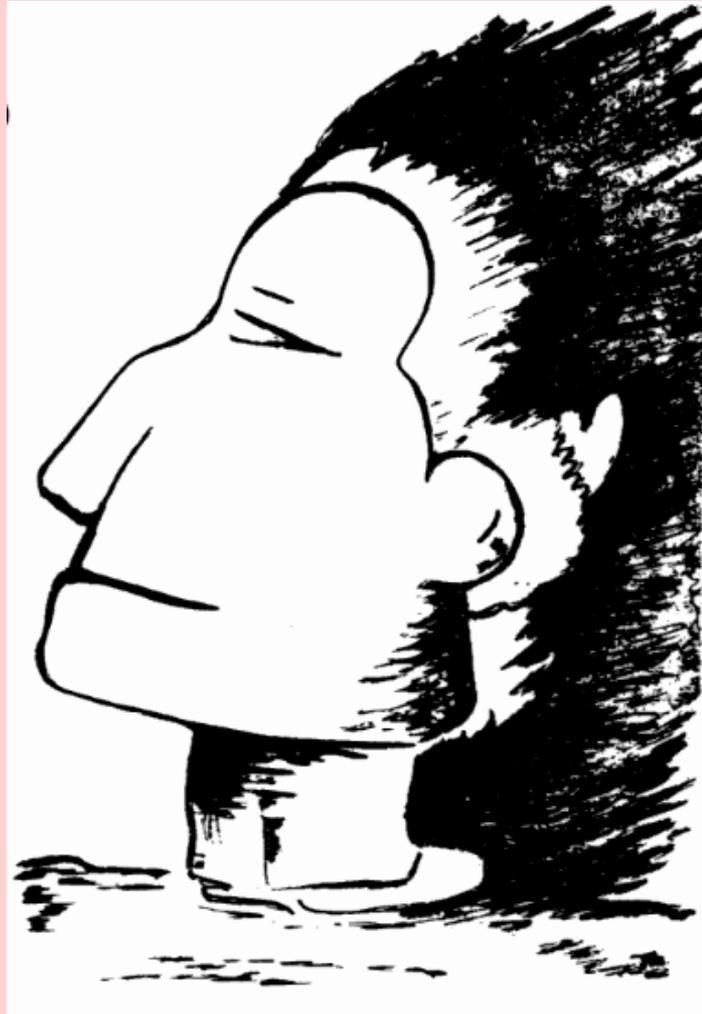
*A Portrait:*

Take a  
moment to  
observe...

What do you  
see? Write it  
down.



How come we are looking at the very same drawing and seeing two different things?

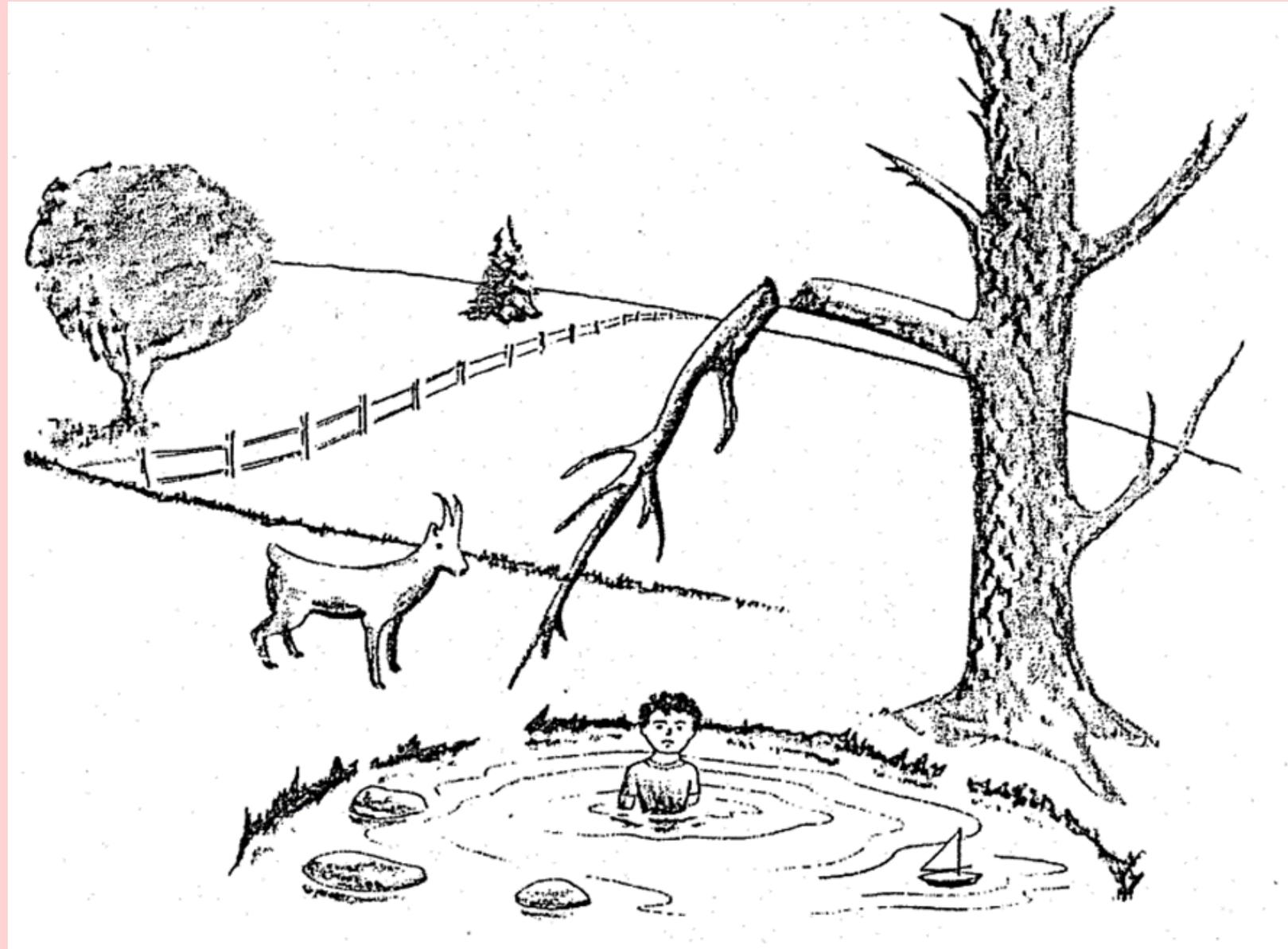


# How does this relate to science?

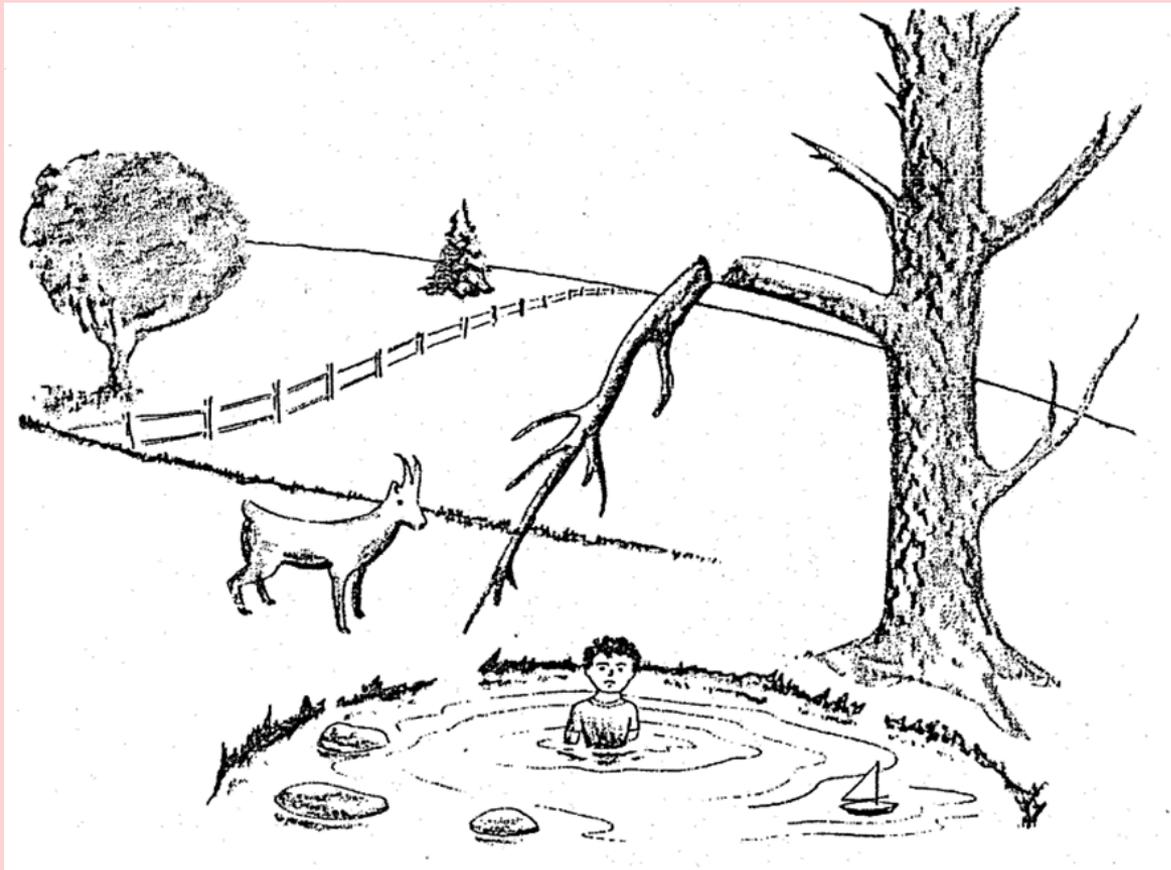
- In the same manner that you were not able to see the face of the young lady in the drawing, scientists sometimes fail to `see' a certain set of evidence as relevant to their questions.
- Scientists sometimes tend to **infer** different things from the same set of data in the same manner that you inferred totally different things from the **same piece of evidence**: *The portrait*.



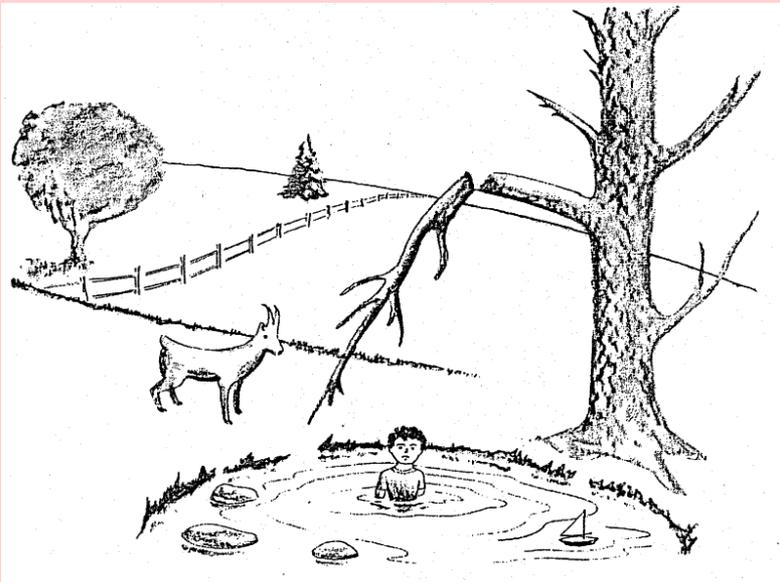
Lets Practice: Look at the picture



Using the handout, indicate whether it is an observation or an inference

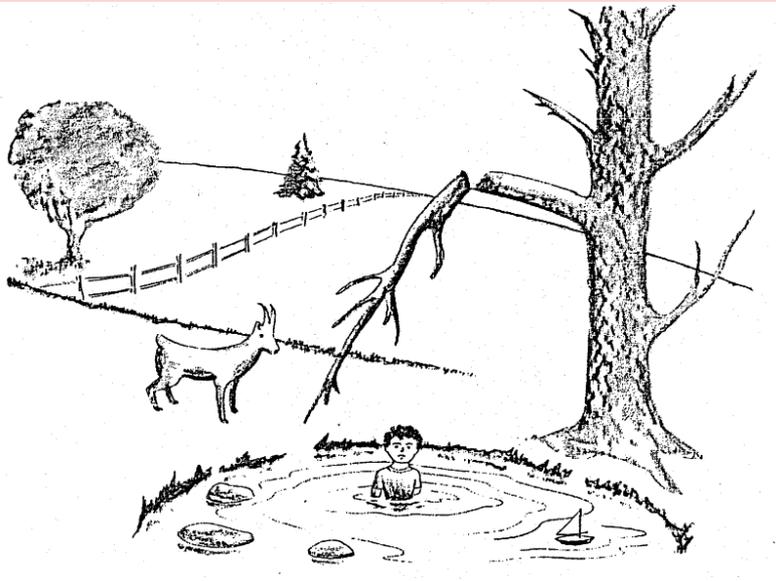


# Observation or Inference?



- \_\_\_\_\_ 1. The kid is in the water
- \_\_\_\_\_ 2. The weather is cold
- \_\_\_\_\_ 3. The tree branch is broken
- \_\_\_\_\_ 4. If the kid crawled out of the water,  
the goat would push him/her
- \_\_\_\_\_ 5. The kid fell off the branch

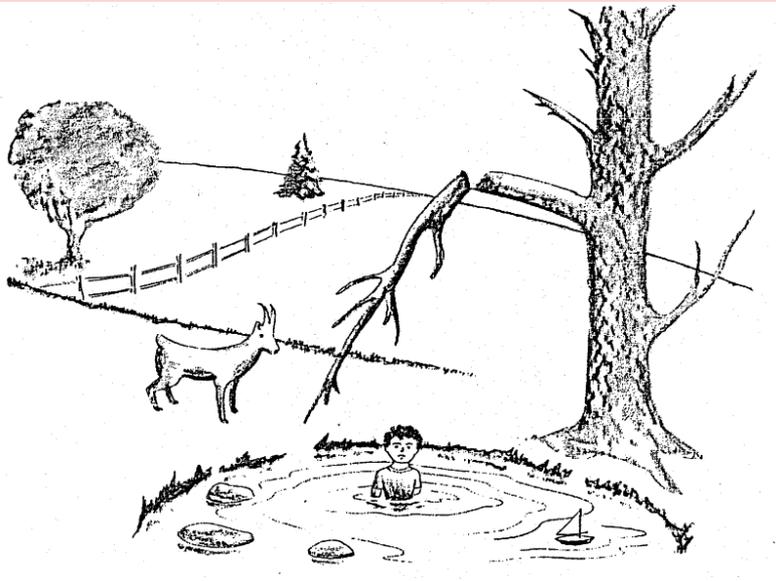
# Obs or Inf?



**OBS**

1. The kid is in the water
2. The weather is cold
3. The tree branch is broken
4. If the kid crawled out of the water, the goat would push him/her
5. The kid fell off the branch

# Obs or Inf?



**OBS**

1. The kid is in the water

**INF**

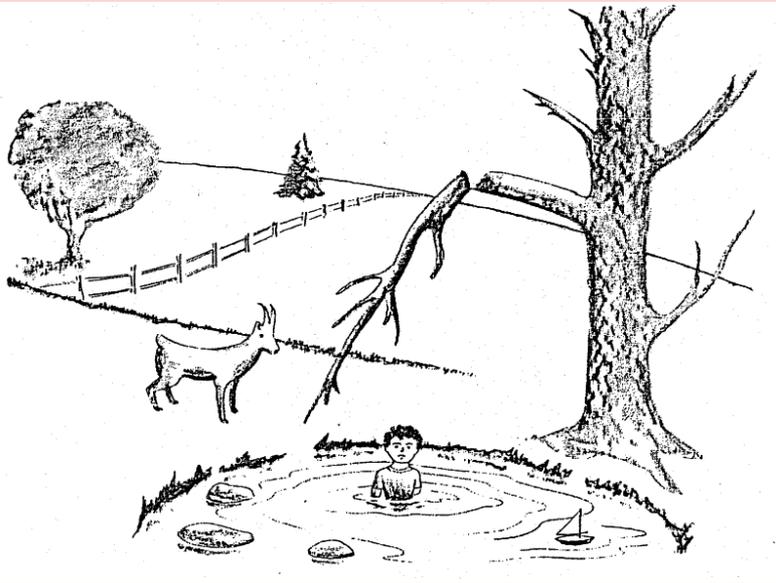
2. The weather is cold

3. The tree branch is broken

4. If the kid crawled out of the water,  
the goat would push him/her

5. The kid fell off the branch

# Obs or Inf?



**OBS**

1. The kid is in the water

**INF**

2. The weather is cold

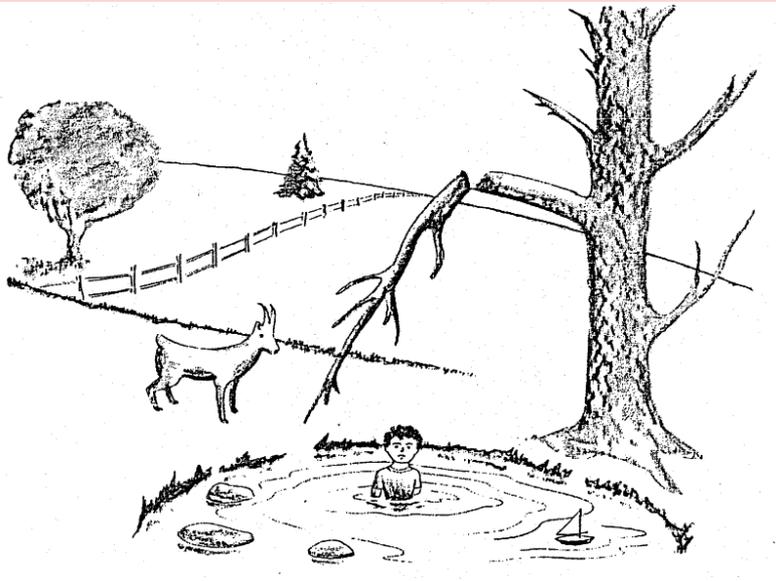
**OBS**

3. The tree branch is broken

4. If the kid crawled out of the water,  
the goat would push him/her

5. The kid fell off the branch

# Obs or Inf?



**OBS**

1. The kid is in the water

**INF**

2. The weather is cold

**OBS**

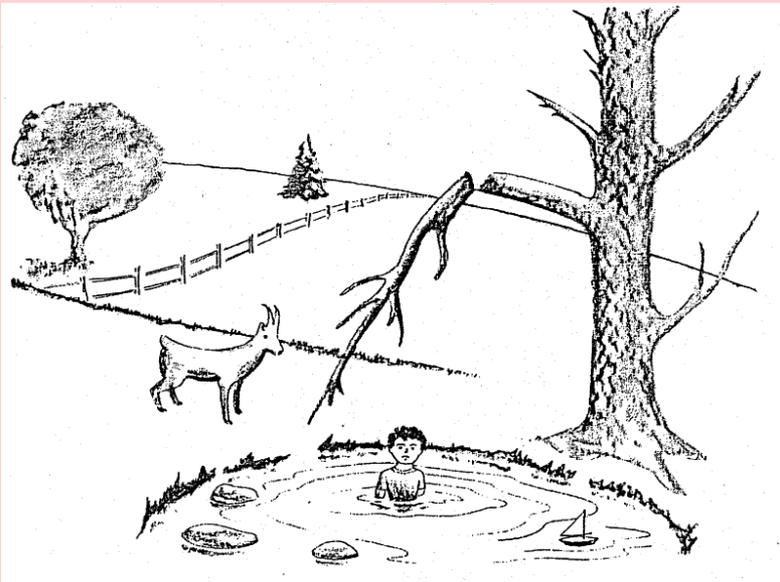
3. The tree branch is broken

**INF**

4. If the kid crawled out of the water,  
the goat would push him/her

5. The kid fell off the branch

# Obs or Inf?



**OBS**

1. The kid is in the water

**INF**

2. The weather is cold

**OBS**

3. The tree branch is broken

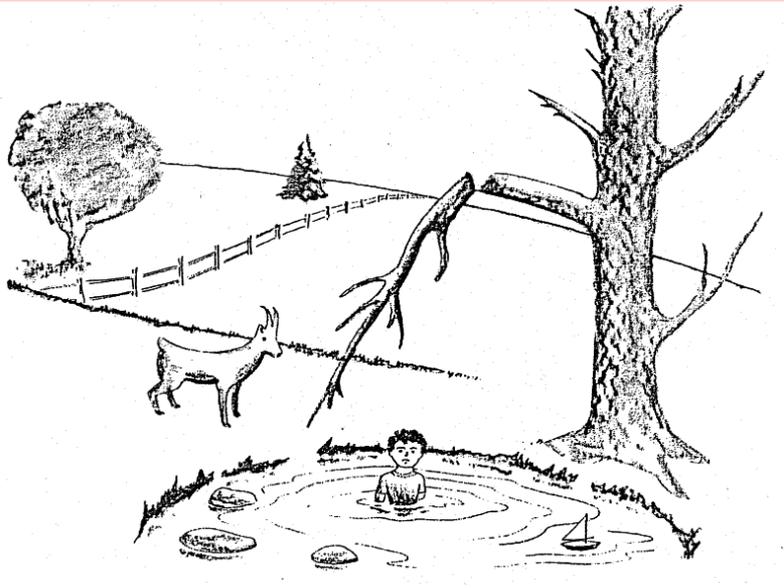
**INF**

4. If the kid crawled out of the water  
the goat would push him/her

**INF**

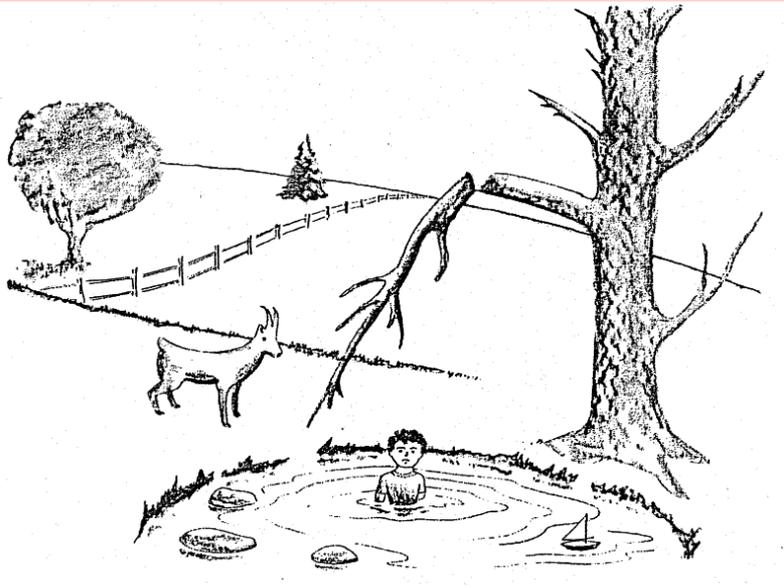
5. The kid fell off the branch

# Obs or Inf?



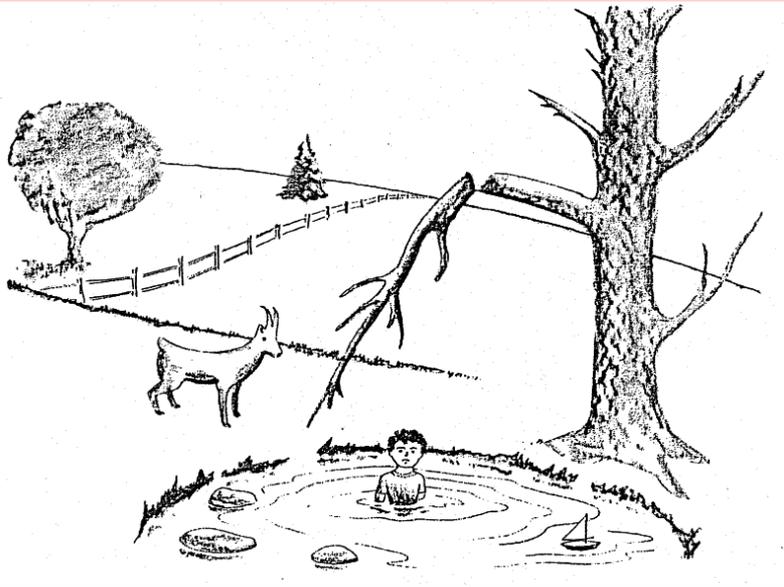
- \_\_\_ 6. The goat is standing by the pond
- \_\_\_ 7. The branch will fall on the kid's head
- \_\_\_ 8. The kid fell off the rocks
- \_\_\_ 9. There is a sailboat in the water
- \_\_\_ 10. The sailboat belongs to the kid

# Obs or Inf?



- OBS** 6. The goat is standing by the pond
7. The branch will fall on the kid's head
8. The kid fell off the rocks
9. There is a sailboat in the water
10. The sailboat belongs to the kid

# Obs or Inf?



**OBS** 6. The goat is standing by the pond

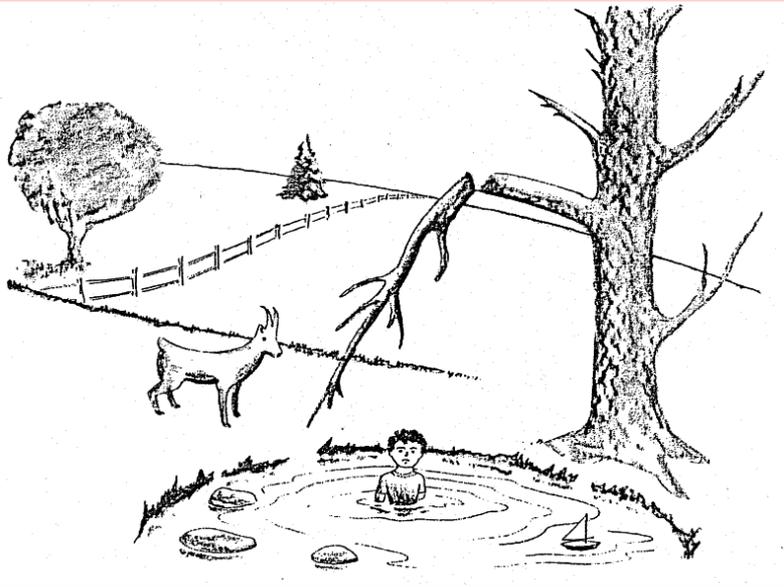
**INF** 7. The branch will fall on the kid's head

8. The kid fell off the rocks

9. There is a sailboat in the water

10. The sailboat belongs to the kid

# Obs or Inf?



**OBS** 6. The goat is standing by the pond

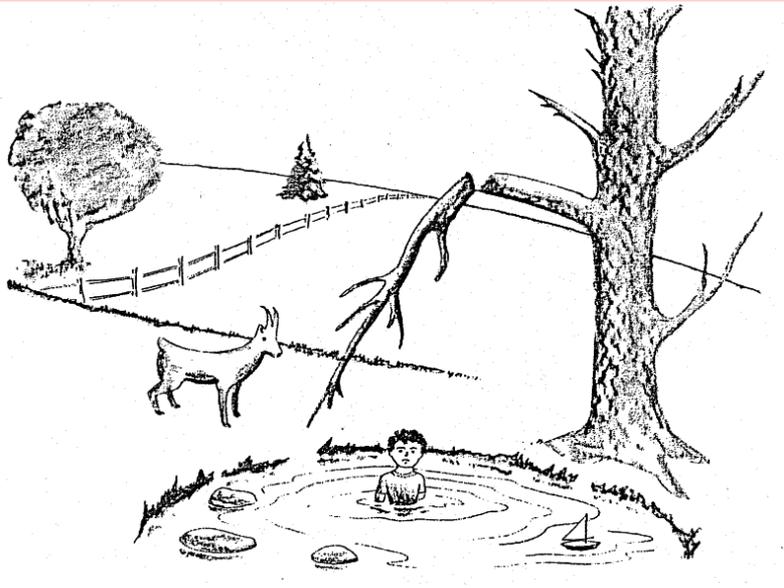
**INF** 7. The branch will fall on the kid's head

**INF** 8. The kid fell off the rocks

9. There is a sailboat in the water

10. The sailboat belongs to the kid

# Obs or Inf?



**OBS** 6. The goat is standing by the pond

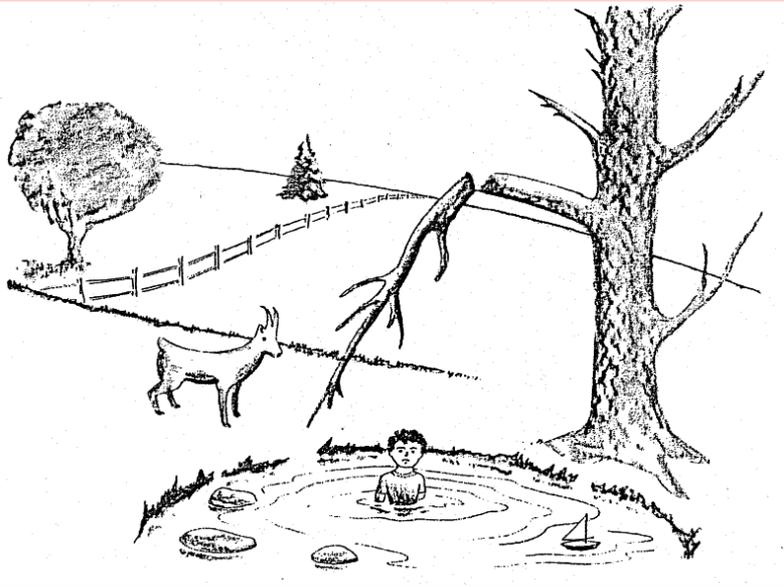
**INF** 7. The branch will fall on the kid's head

**INF** 8. The kid fell off the rocks

**OBS** 9. There is a sailboat in the water

10. The sailboat belongs to the kid

# Obs or Inf?



**OBS** 6. The goat is standing by the pond

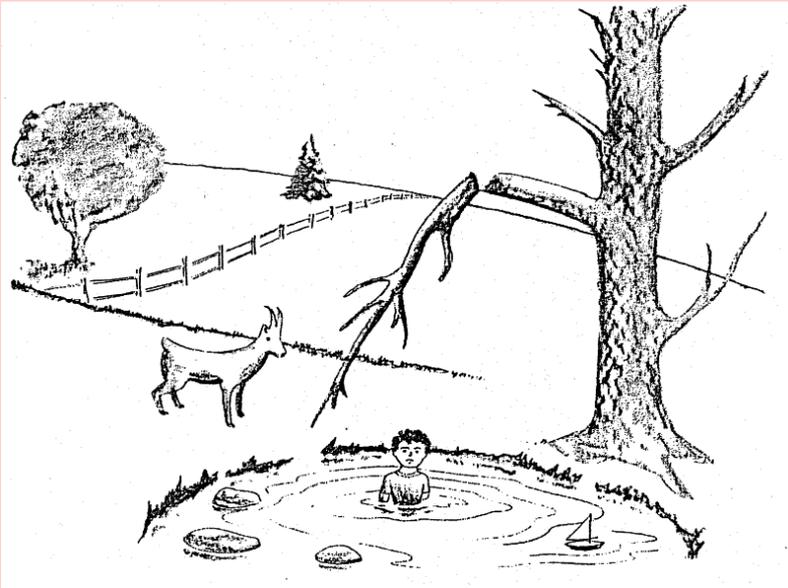
**INF** 7. The branch will fall on the kid's head

**INF** 8. The kid fell off the rocks

**OBS** 9. There is a sailboat in the water

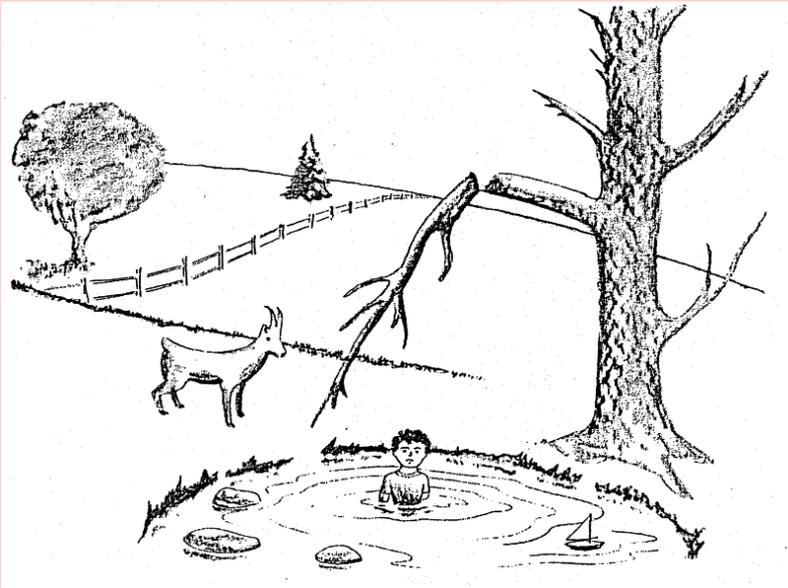
**INF** 10. The sailboat belongs to the kid

# Obs or Inf?



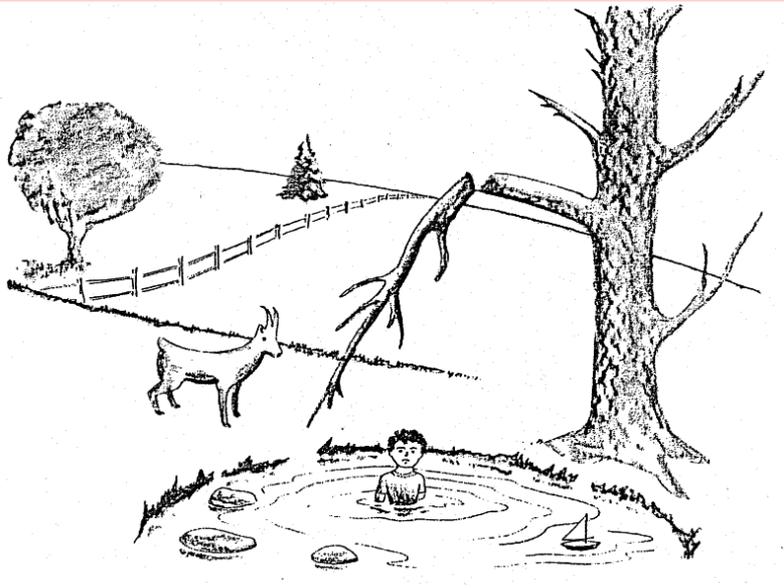
- \_\_\_ 11. The goat will soon leave the pond
- \_\_\_ 12. The tree by the pond has no leaves
- \_\_\_ 13. There are three rocks in the pond
- \_\_\_ 14. The tree by the pond is dead
- \_\_\_ 15. If it rains, leaves will grow on the tree
- \_\_\_ 16. The goat pushed the kid into the pond

# Obs or Inf?



- INF** 11. The goat will soon leave the pond
12. The tree by the pond has no leaves
13. There are three rocks in the pond
14. The tree by the pond is dead
15. If it rains, leaves will grow on the tree
16. The goat pushed the kid into the pond

# Obs or Inf?



**INF** 11. The goat will soon leave the pond

**OBS** 12. The tree by the pond has no leaves

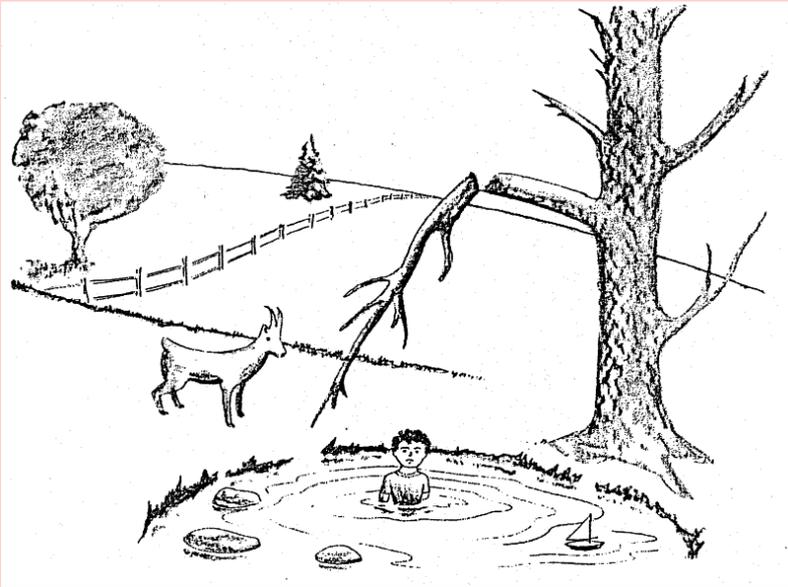
13. There are three rocks in the pond

14. The tree by the pond is dead

15. If it rains, leaves will grow on the tree

16. The goat pushed the kid into the pond

# Obs or Inf?



**INF** 11. The goat will soon leave the pond

**OBS** 12. The tree by the pond has no leaves

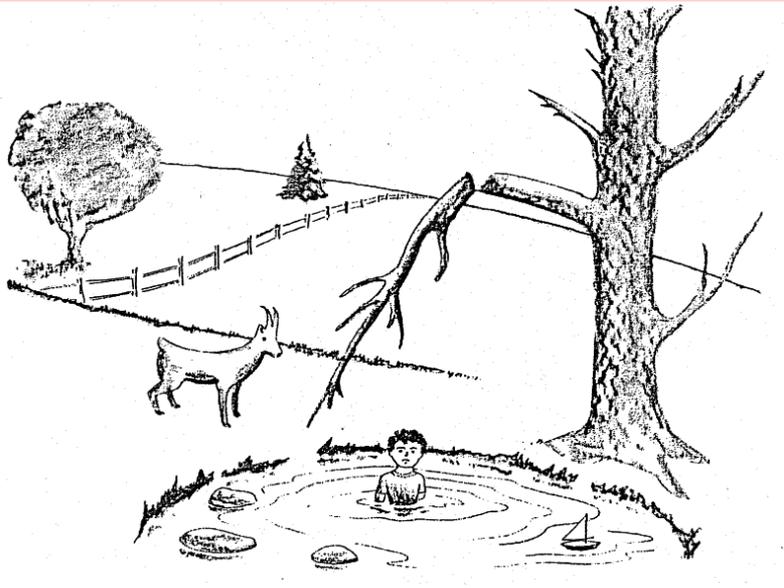
**OBS** 13. There are three rocks in the pond

14. The tree by the pond is dead

15. If it rains, leaves will grow on the tree

16. The goat pushed the kid into the pond

# Obs or Inf?



**INF** 11. The goat will soon leave the pond

**OBS** 12. The tree by the pond has no leaves

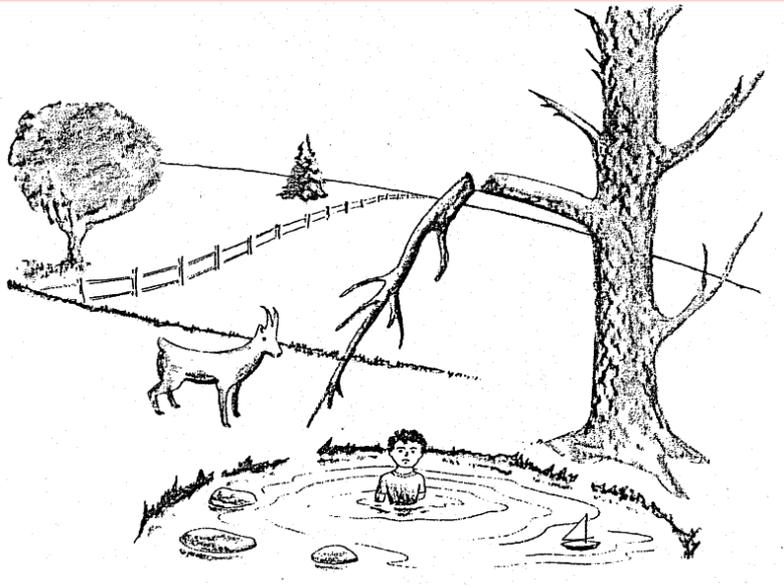
**OBS** 13. There are three rocks in the pond

**INF** 14. The tree by the pond is dead

15. If it rains, leaves will grow on the tree

16. The goat pushed the kid into the pond

# Obs or Inf?



**INF** 11. The goat will soon leave the pond

**OBS** 12. The tree by the pond has no leaves

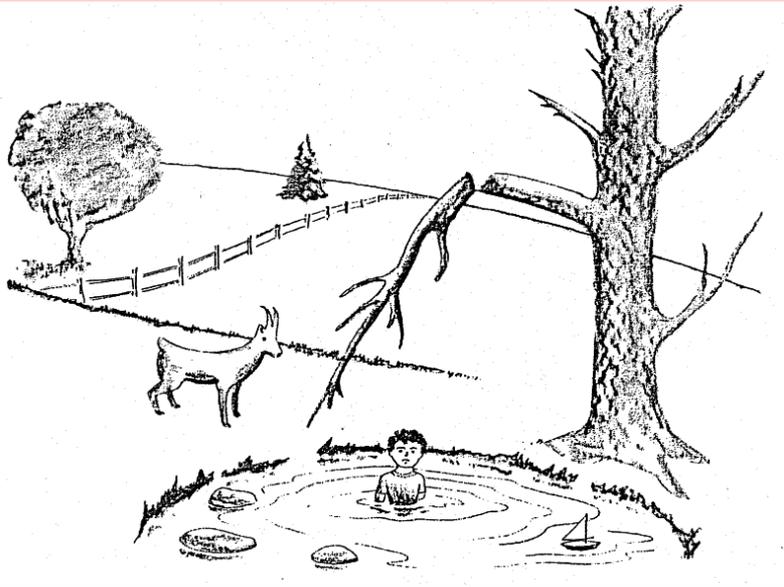
**OBS** 13. There are three rocks in the pond

**INF** 14. The tree by the pond is dead

**INF** 15. If it rains, leaves will grow on the tree

16. The goat pushed the kid into the pond

# Obs or Inf?



**INF** 11. The goat will soon leave the pond

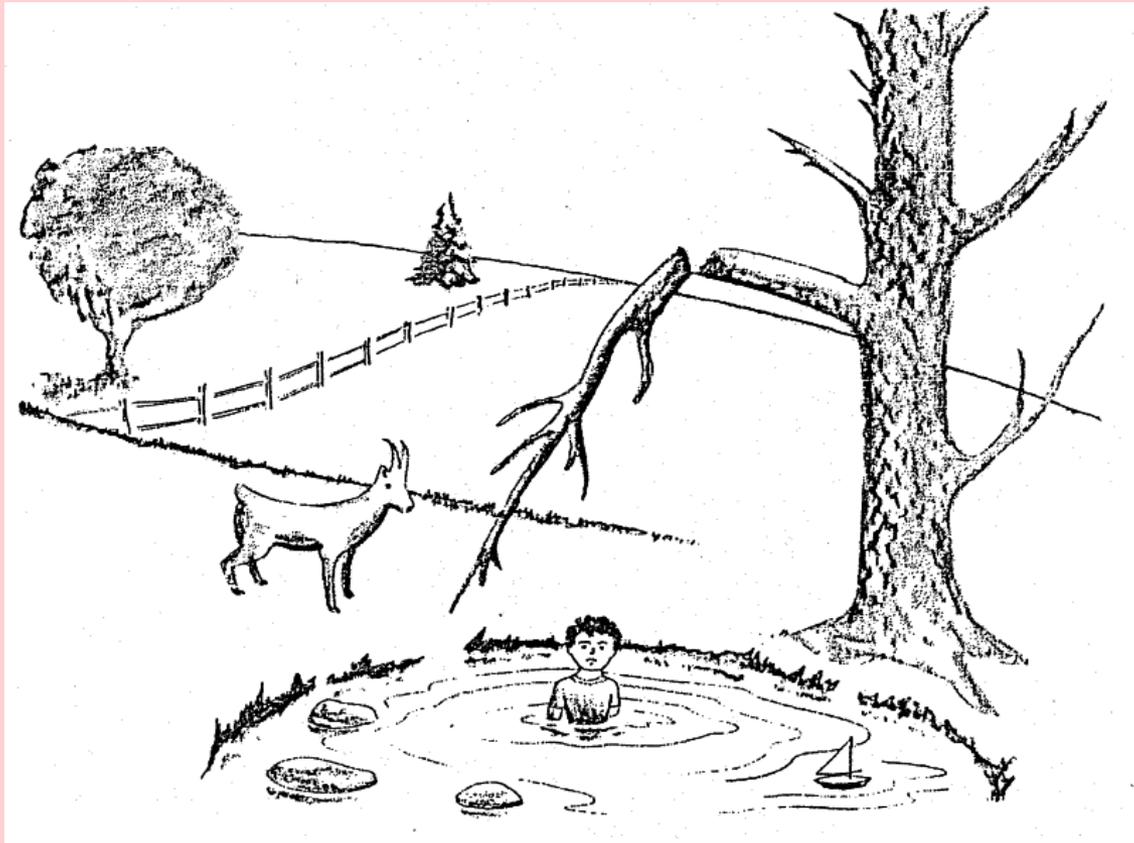
**OBS** 12. The tree by the pond has no leaves

**OBS** 13. There are three rocks in the pond

**INF** 14. The tree by the pond is dead

**INF** 15. If it rains, leaves will grow on the tree

**INF** 16. The goat pushed the kid into the pond



**Make your own inference**

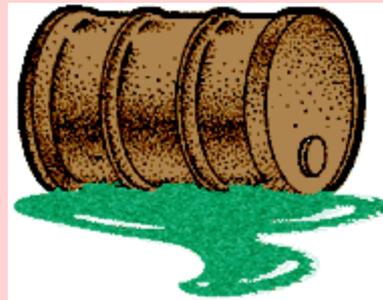
# Observation v. Inference

- Based on the same set of evidence- many equally warranted answers to the same question can be inferred.
- Scientists make similar inferences as they attempt to derive answers to questions about natural phenomena
- No single answer (or story) may solely account for that evidence...several answers are often plausible
- Scientists may simply never find the answer as to what has really happened.

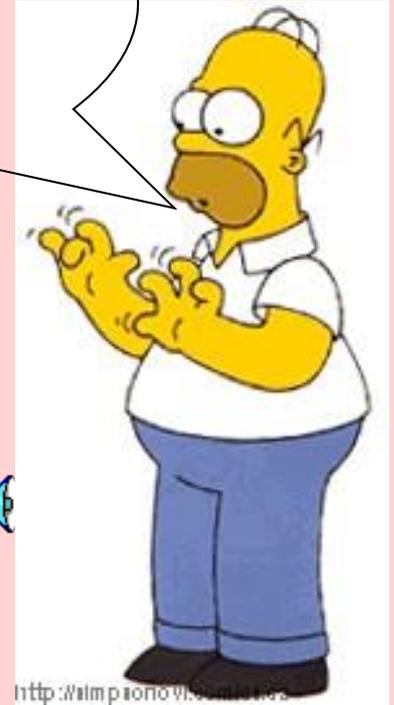
# What is this?

When studying something describe only facts that you can see, touch, smell and hear. You are not making any guesses.

**THIS IS NOT AN  
OPINION!!**



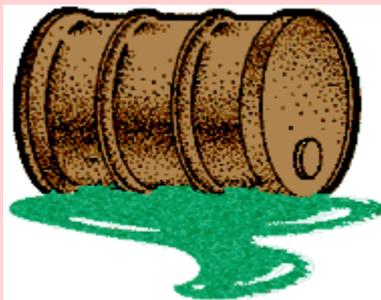
Ohh... This liquid is **green** and it is leaking from a **brown** can. I also smell it.



# What is this?

using your observations  
to make a **guess** about  
an object or an outcome

**THIS CAN BE A  
SCIENTIFIC  
OPINION**



Based on my  
**observations**, I **think** that  
this can is **old** and is  
leaking a **toxic** substance.



<http://wimpiaonline.com>

## 2. Knowledge comes from observation

- Observation and experimentation
- Empirical Knowledge: gained through experience
- Indigenous Knowledge: understandings, values and beliefs about the natural world that are unique to a particular group or culture that has lived in the area for a long time.
  - Oral tradition passed on through generations

### 3. Scientific knowledge is tentative but reliable

- Looks for patterns and regularities
- Patterns lead to laws
- Laws lead to predictions

- *Theories* and *laws* are different kinds of knowledge- one can not become the other
  - *laws* are statements or descriptions of the relationships among observable phenomena
  - *theories* are inferred explanations for observable phenomena
- **Theories or laws** can not be proven true but can be proven false.
- However both are extensively tested and supported

# Newton's Gravitational Laws

- If we found a place where objects “fell upwards” then we would have to revisit Newton's laws of motion

## 4. Science is Progressive

- Theories are never FINAL and are always being examined and questioned.
- New evidence can change theories

# Lets check out an article.....

- Silently read the article
- Get into partners to complete the response page
- We will discuss as a group the implications of this compound.

# Critical Thinking

- We need to be aware of where we are getting our information from?
  - Is it credible?
  - Is it reliable?
  - CRAAP Test

# What isn't Science?

- ❑ Non-Science- Often religious or historical
- ❑ Psuedoscience-claim of science background
- ❑ Faulty science- bias, inappropriate experiments
- ❑ Hoaxes/Fraud- Greed/desire/fame
- ❑ Urban Legends-Folklore

# Myth or Fact?!?!

- ❑ In pairs, use critical thinking to determine if these are urban legends or fact
- ❑ Each set of partners will investigate one of the statements and present to the class their findings.



# Scientific Inquiry



# Types of Scientific Inquiry:

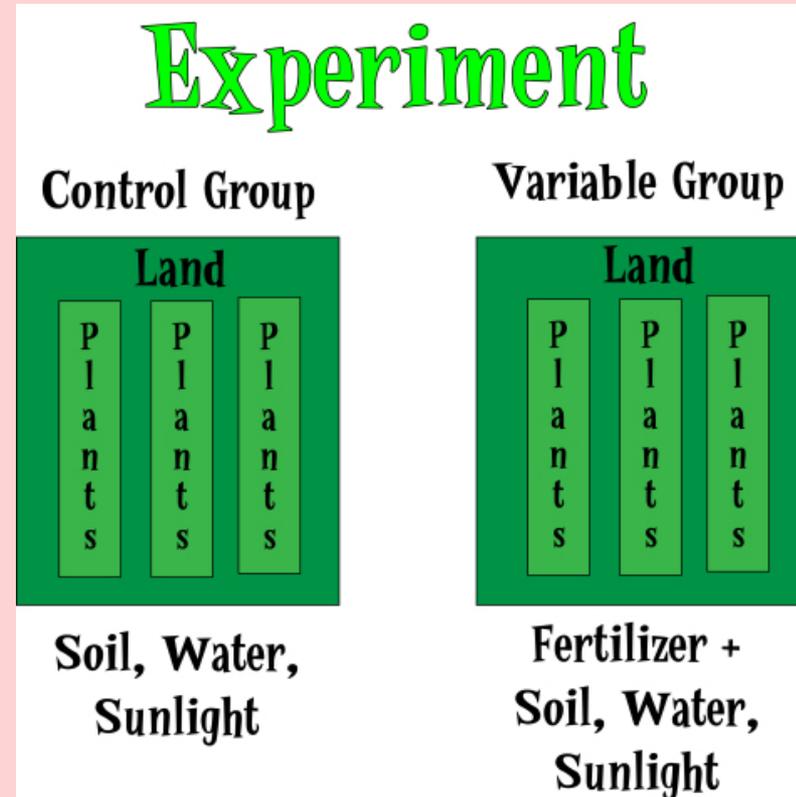
## 1. **Controlled experiment:**

Determines the relationship of two variables that you can control

- Ex: You observe that grass is not growing on your lawn. You ask yourself why? You may suggest a number of possible answers and eventually come up with a hypothesis (possible explanation for your observations). You think it is because the lawn needs fertilizer.
- From this you can make a prediction to be tested
  - Predict that adding fertilizer will allow new grass to grow
  - You now need to identify all of the variables that could affect the experiment

# Scientific Inquiry

- Variable: any condition that could \_\_\_\_\_ in an investigation
- Independent Variable: the variable that the investigator in an experiment changes
- Dependant Variable: the variable that changes in response to the independent variable
- Controlled Variable: variables controlled by the investigator.



- It is also important to have a control. This is a reference for the experiment to be compared to.
  - Essential to see if a change occurred.
  - In this example you could have two patches of grass, one with fertilizer and one without(control)

# Does fertilizer help grass grow?

- ❑ How could I test this?
- ❑ Identify all variables that could affect grass growth
- ❑ What would be the independent variable?
- ❑ Dependant variable?
- ❑ Control?



- Correlation Study: look at a suspected relationship between two variables
  - Smoking and lung cancer
  
- Observational Study: when variables are not controlled(either by inability or investigators choice)
  - Ecology

# Observation



# Prediction

- What you think will happen



# Hypothesis

- *educated guess* based upon observation. It is a rational explanation of a single event or phenomenon based upon what is observed, but which has not been proved



# Planning

- Plan an experiment to test your hypothesis
  - Variables, controls
  - What you will do
  - How you will do it
  - How it will be measured
  - Materials
  - Equipment
  - Safety



# Conducting

- ❑ Follow procedure
- ❑ Record any modifications



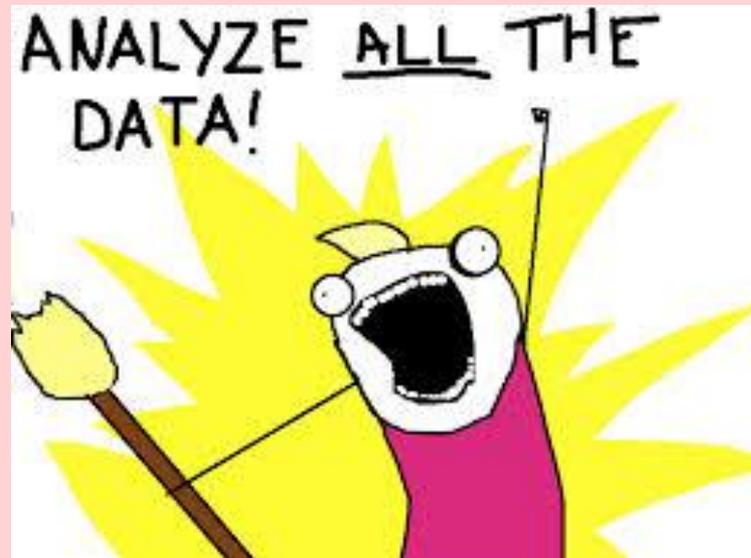
# Recording

- Data
- Qualitative vs Quantitative



# Analyzing

- Carefully study data



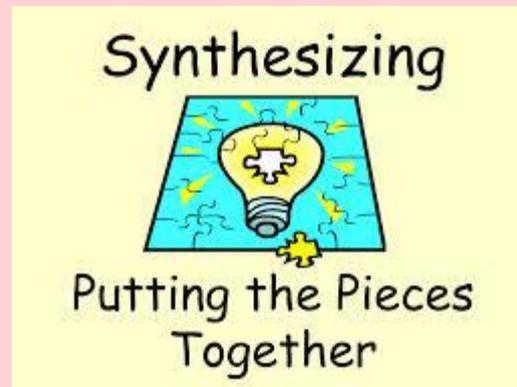
# Evaluating

- ❑ Did what I think would happen, happen?
- ❑ What worked?
- ❑ What went wrong?
- ❑ Did anything change?
- ❑ What would you do differently



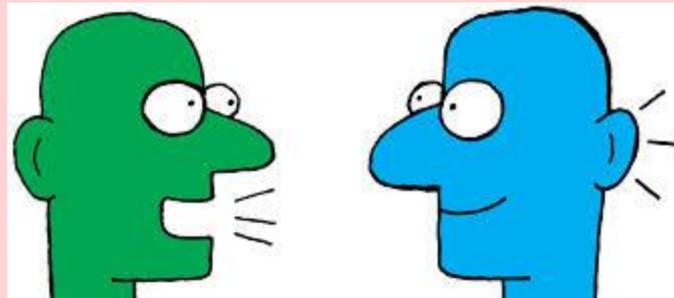
# Synthesizing

- What can you do now?
- Where can this lead?



# Communicating

- Sharing with others
- Lab report
  - Anyone should be able to pick up the lab report and be able to replicate the lab.



Practice 😊

# Gummy Bears & The Scientific Method

