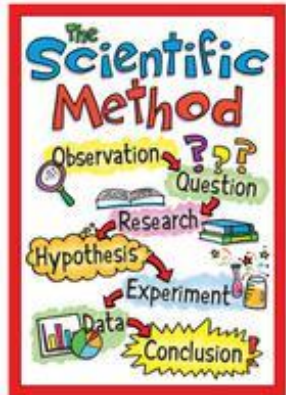


# INITIAL OBSERVATION



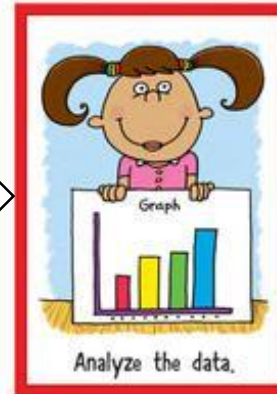
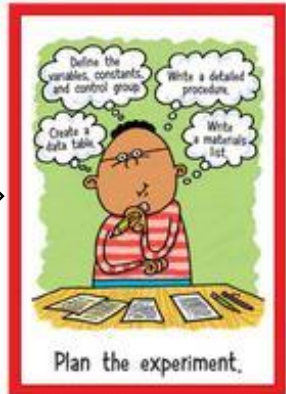
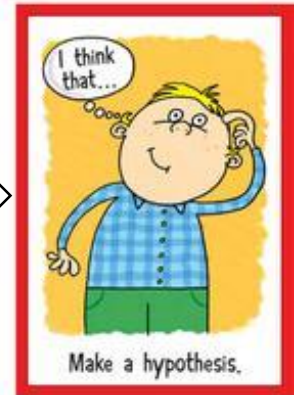
## WONDER



## RESEARCH



## HYPOTHESIZE

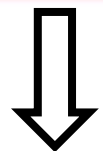


## PLAN

## EXPERIMENT ADDITIONAL OBSERVATIONS

## DATA

## ANALYSIS



## CONCLUSION!

# Observation



- Observation is describing an object or event using your five senses (*what you see, hear, smell, taste, touch*) or measurement (*numbers*).
- Information gathered during an observation is called **data** (sing. *datum*).

Observation **does not include opinion**  
(how you *feel* or what you *think*)!

# Describe the Elephant



**It weighs 480 kilograms.**

**It has large ears and long trunk.**

**It has gray wrinkly skin.**

~~**It is very cute!**~~

**It is young.**

**It is about 1.5 yards tall.**

# Qualitative vs Quantitative Data

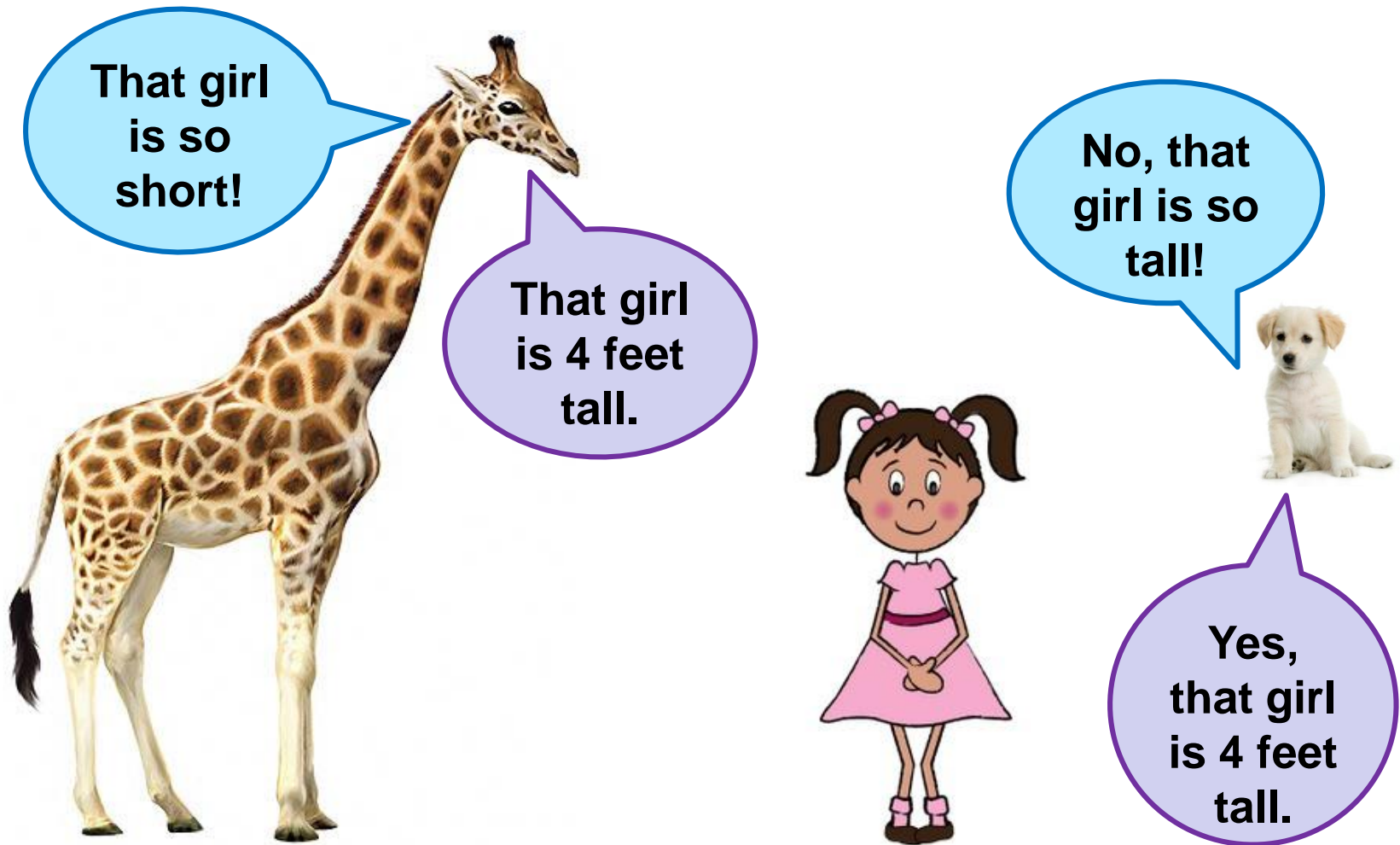
## Qualitative (letters)

- **Descriptions** using **words**.
- Data which can be **observed** but **not measured**.
- What the object is *like*: texture, smell, taste, appearance, etc.
- ***Subjective, relative***

## Quantitative (numbers)

- Specific **numbers**.
- Data which can be **measured**.
- Length, height, area, volume, weight, speed, time, temperature, humidity, sound levels, cost, age, etc.
- ***Objective, specific***

# Qualitative observations are **subjective**



Quantitative observations are **objective**



# Measurement

- the **assignment of numbers** to objects or events
- a type of **quantitative observation** made with a **measuring instrument**
- includes both a **number** and a **unit**
- **units** of measurement are essentially **arbitrary**:  
**people make them up** and then **agree to use them**

**Measuring is an important part of everyday life!**

**What** can we measure?

**Why** do we measure?

**How** can we measure?

**How well** can we measure?

## WHAT can we measure?

- Length
- Distance on land
- Depth of water
- Mass
- Temperature
- Time
- Light
- Electric current
- Color

## And HOW?

- ✓ Ruler
- ✓ Measuring Chain/Tape
- ✓ Sonar (echo sounder)
- ✓ Weighing scale
- ✓ Thermometer
- ✓ Clock, timer
- ✓ Photometer
- ✓ Ammeter
- ✓ Spectrometer

**AND  
SO  
ON...**

# How good is the measurement?

- **Accuracy** is how close a measured value is to the *actual (true) value*.
- **Precision** is how close the measured values are to *each other* (repeatability and reproducibility).
- **Bias** is a built-in (systematic) error which makes *all measurements wrong by a certain amount*.

