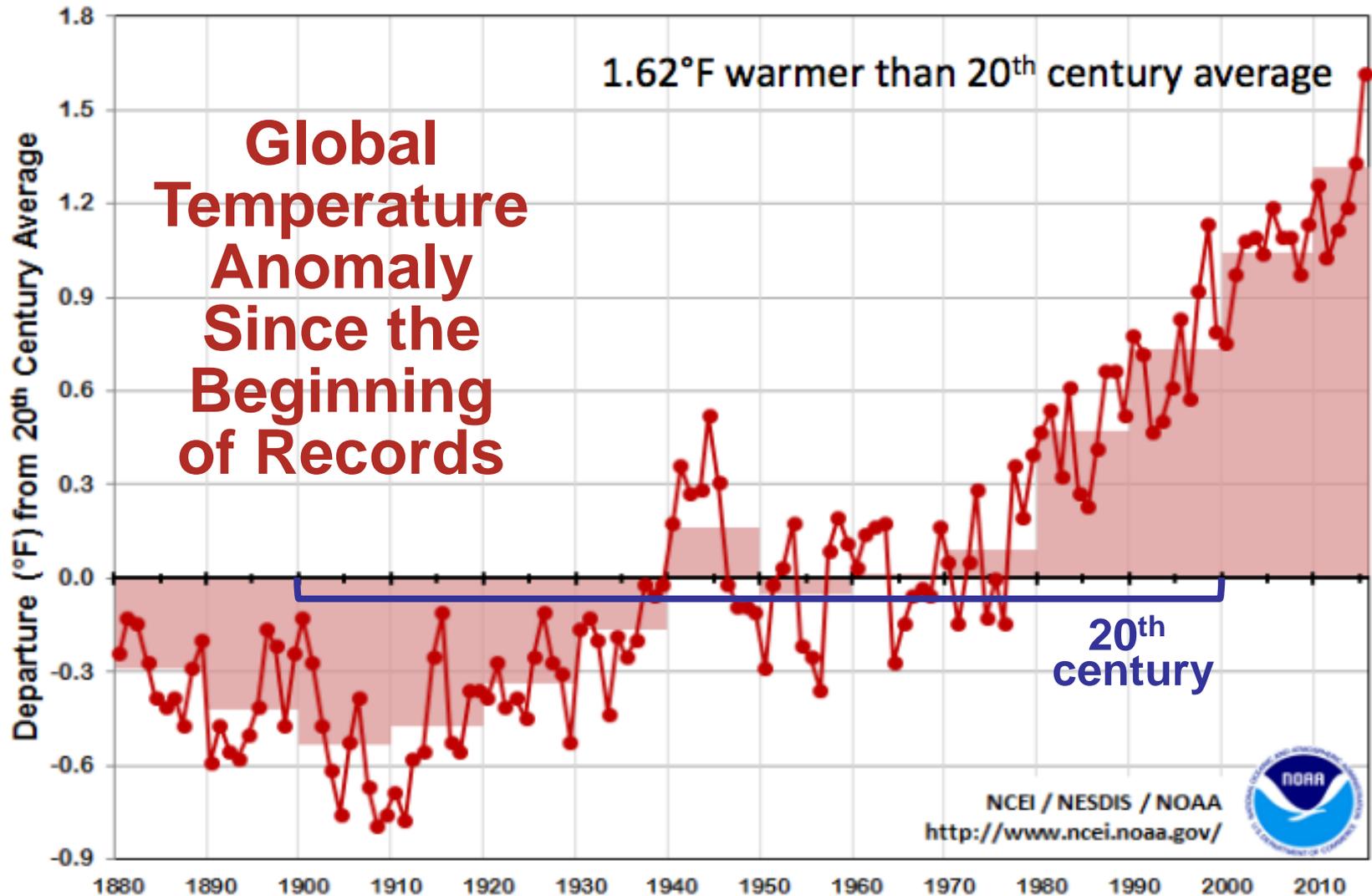
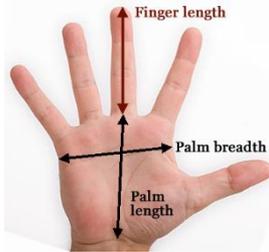
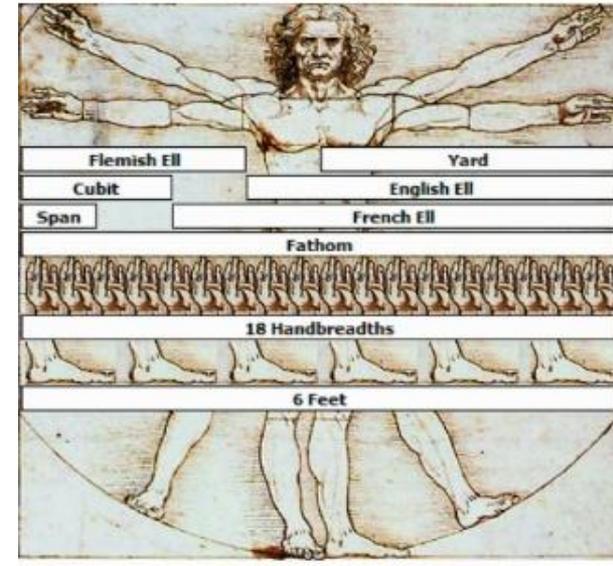


# Most Watched and Debated Graph: Climate Change





# Measurement



# 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 good** can we measure?

## WHAT can we measure?

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

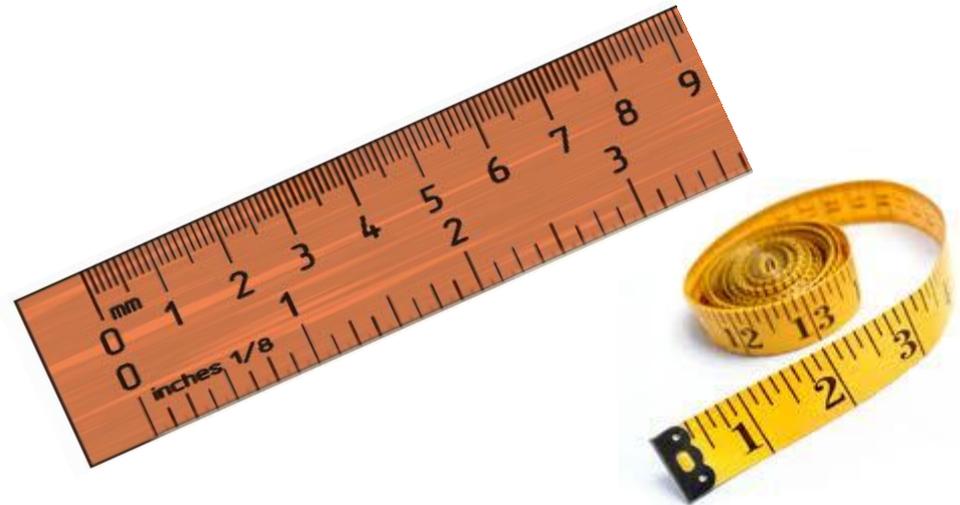
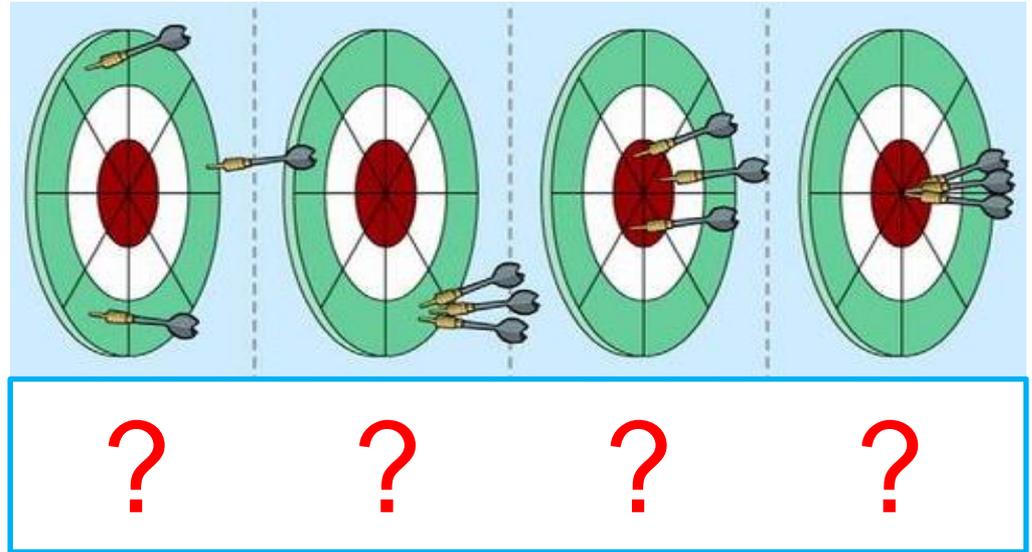
## And HOW?

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

**AND  
SO  
ON...**

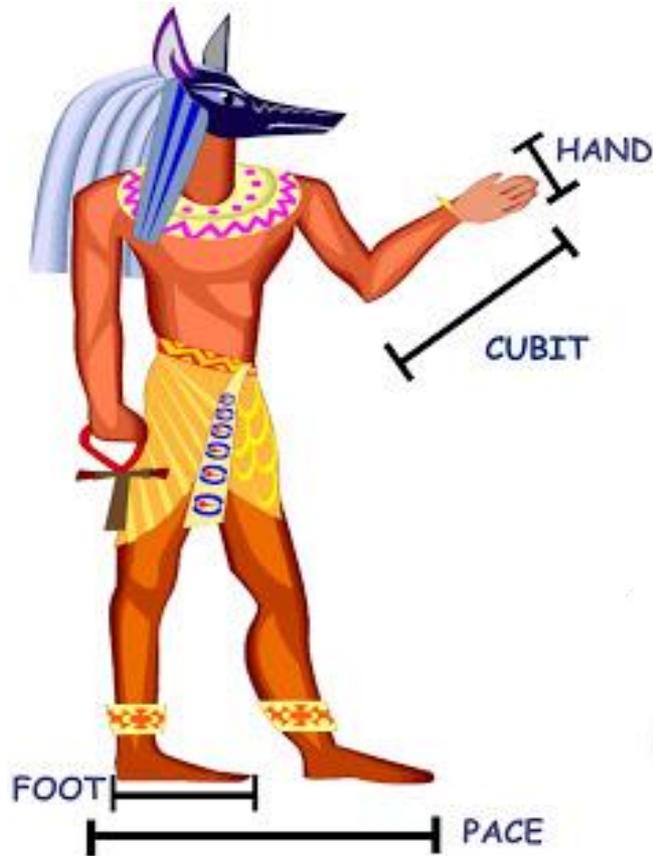
# How good is the measurement?

- **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*.

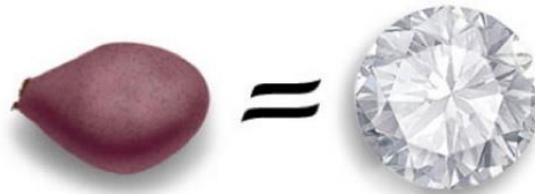


# History of Measurement

- Objects were initially measured for *convenience*, to *aid commerce* and *prevent fraud*.



- The **Egyptians** among other civilizations **were the first to begin recording measurements** around 3200 BC.
- **Early** measurements were based on **body parts** or **common objects**.



1 Carob Seed = 1 Carat

**Find out  
more in your  
homework!**

# Problems with Early Measurement Units

1. People have different sized body parts, as well as there is a variety among common objects like grains...



Grain, India



Barleycorn



Wheat

2. ...so measurements are not accurate, especially when dealing with fractions and multiples...

**SOLUTION: Standard Measurement Systems!**

# What is a System of Measurement?

A system of measurement is a collection of units of measurement and rules relating them to each other.

- Must have **base units** defined for all major quantities that need to be measured (example: a *foot*).
- Must specify **equivalency** relationship for all **additional units** used to measure the same quantity (example: length can also be measured in *inches* or *miles*, defined as 1 foot = 12 inches, 1 mile = 5280 feet).

Systems of measurement have historically been **important, regulated** and **defined** for the purposes of science and commerce.