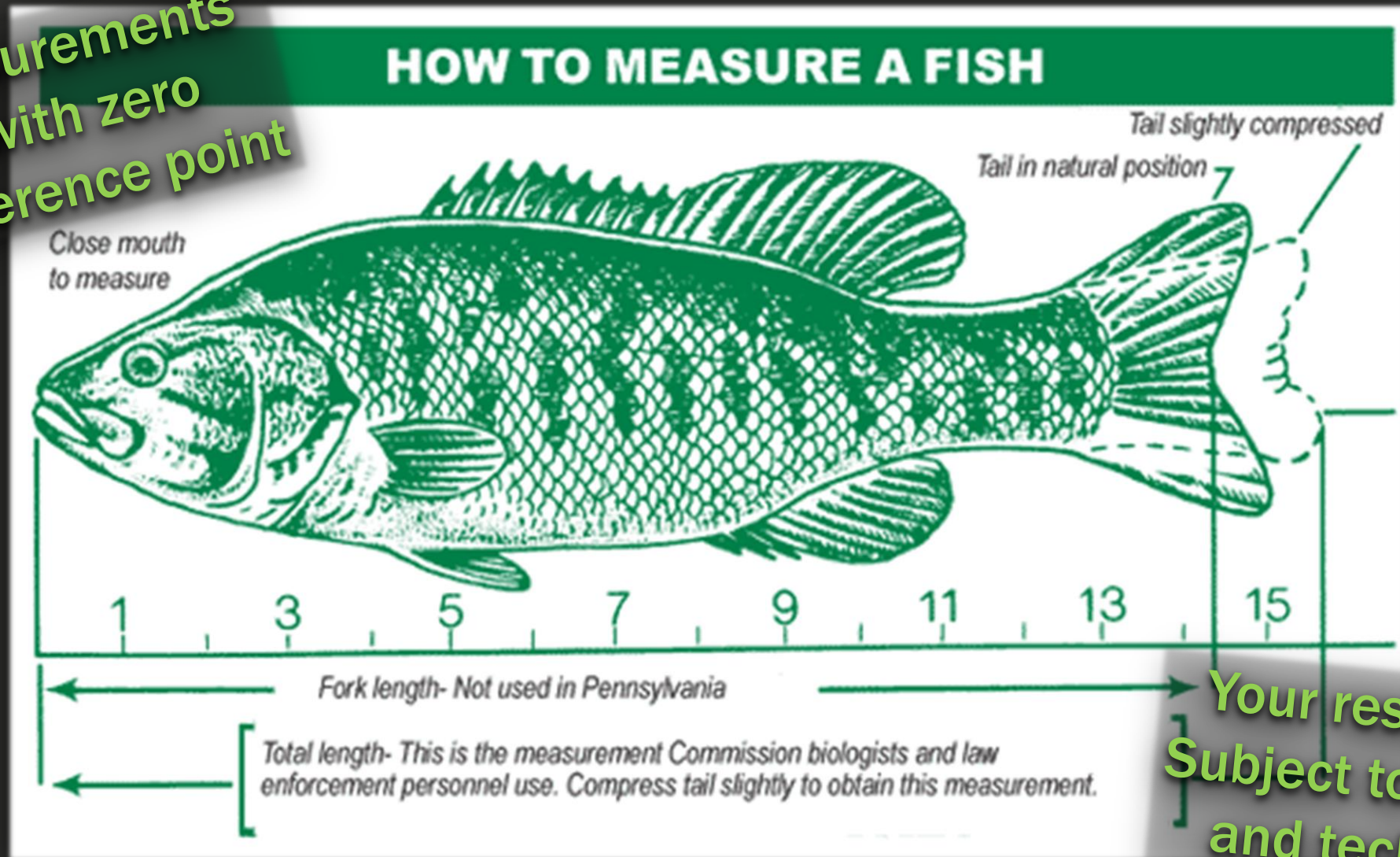




# HOW DOES IT WORK: LAB EQUIPMENT AND PH METERS

Eric Link  
**LABTRONX**

All measurements  
start with zero  
or a reference point



Your results are  
Subject to method  
and technique





HOW DID A METER WORK?



HOW DOES A METER WORK?



# THE THREE BASIC PARTS OF EVERY METER



Sensor



Processor



Human  
Interface

# THE SENSOR'S JOB



# Sensor





# THE PROCESSOR'S JOB

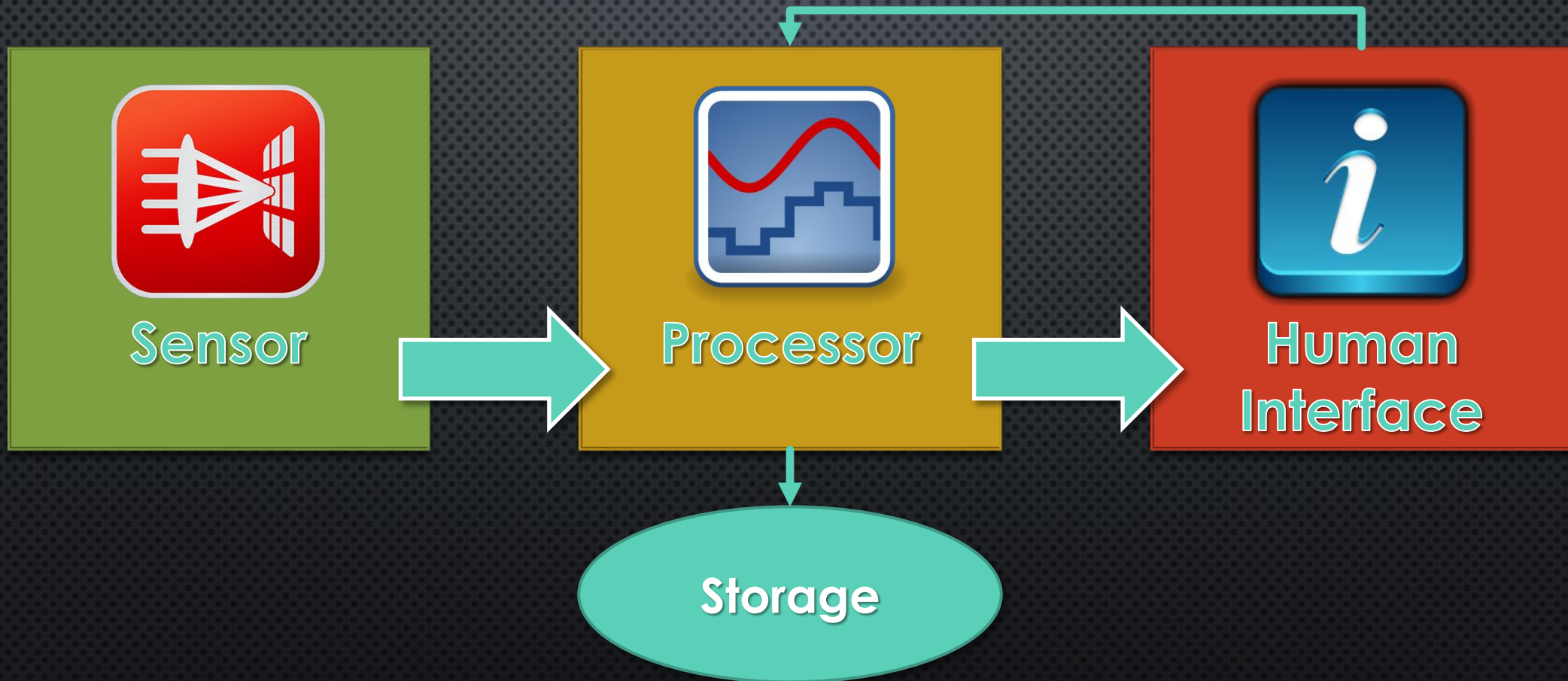


# THE HUMAN INTERFACE'S JOB

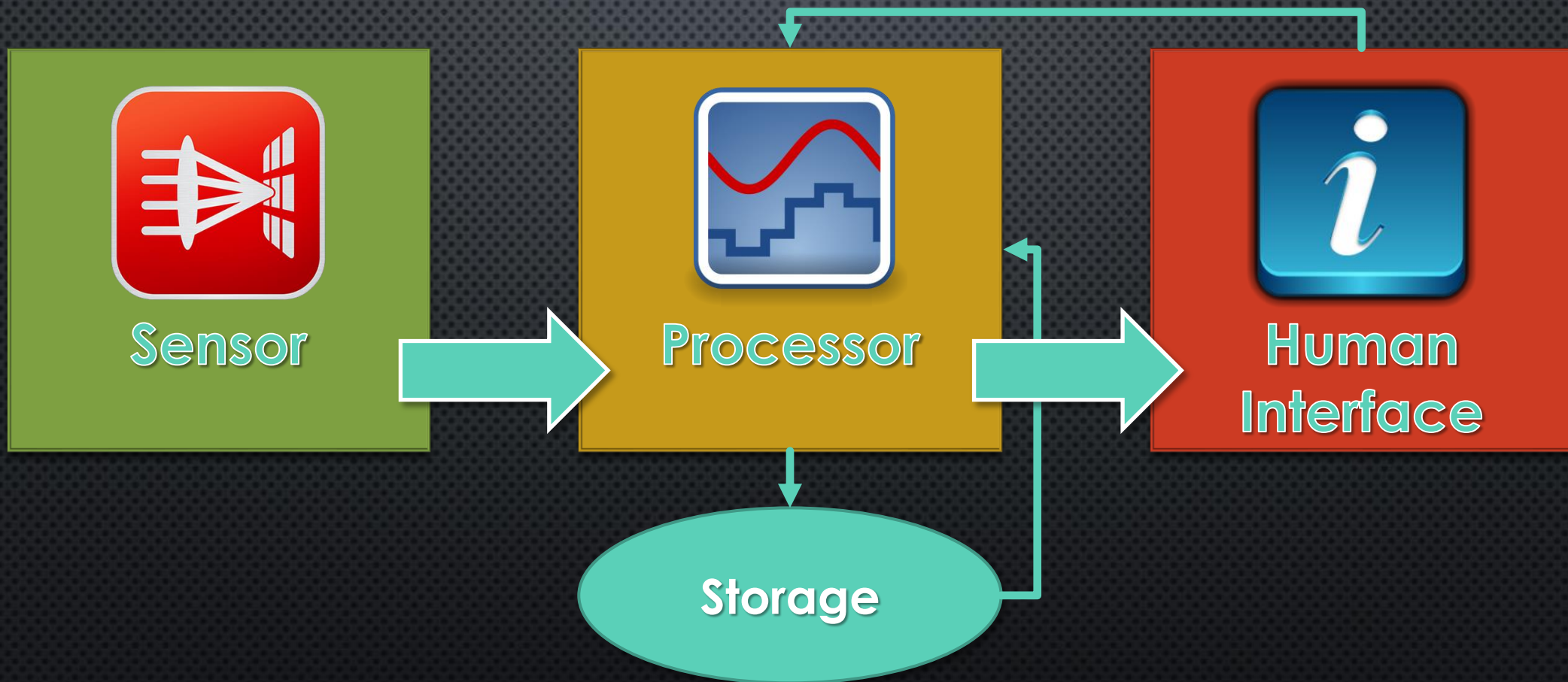




# HOW HUMANS INTERFACE WITH THE METER

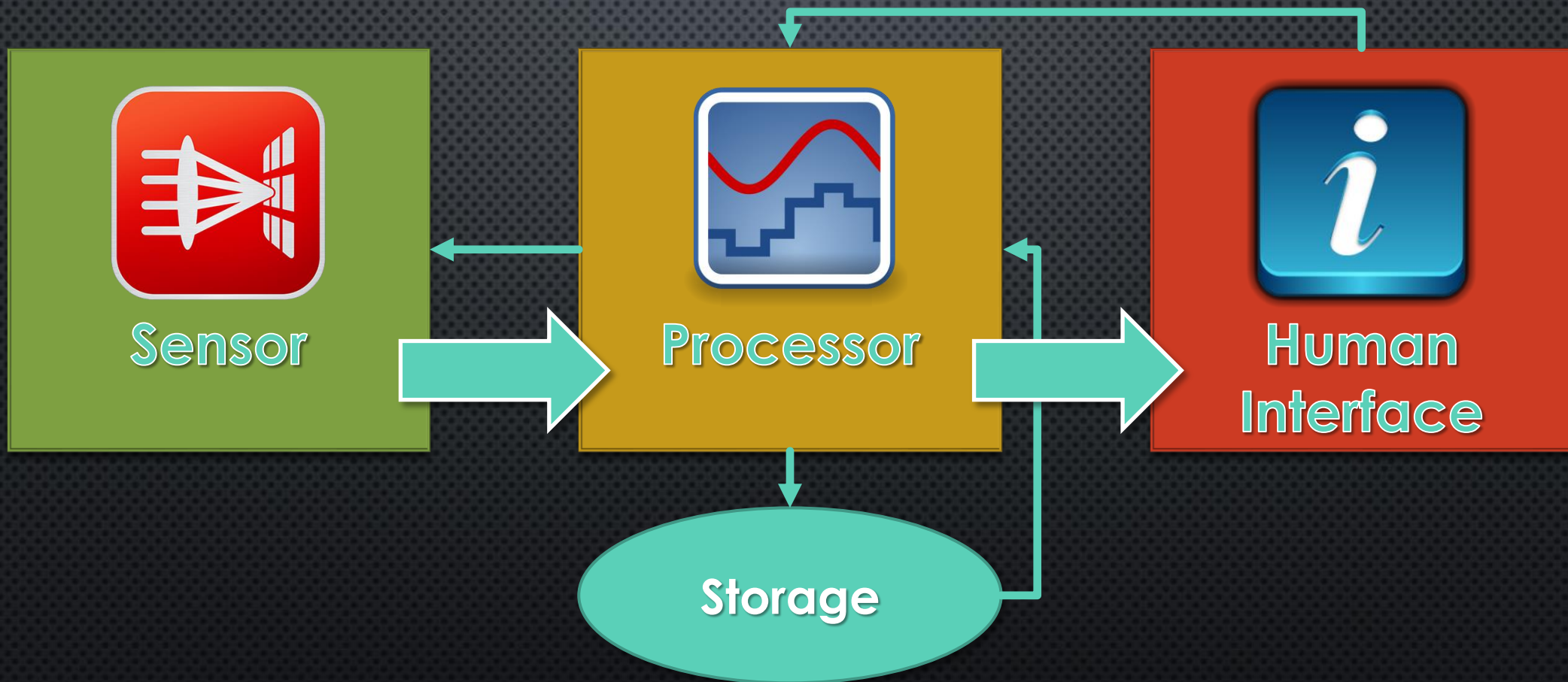


# HOW STORAGE EFFECTS THE PROCESSOR





# HOW THE METER MIGHT CHANGE THE SENSOR



Accuracy vs  
precision





▶ A digital alarm clock assures precision...

but not accuracy





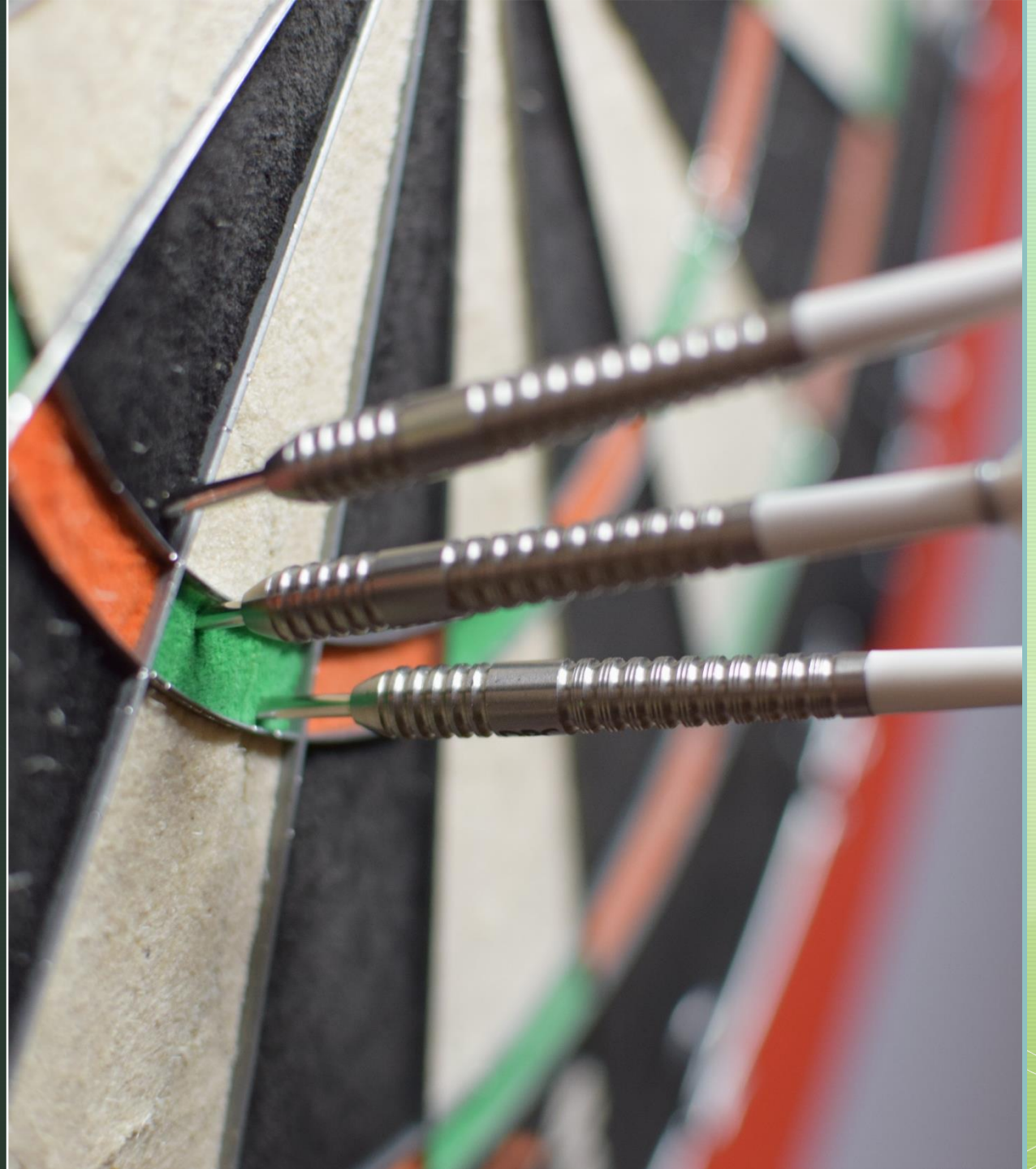
Accuracy Is...

Getting close  
to the  
bullseye



▀ Precision is...

Getting  
the same  
results



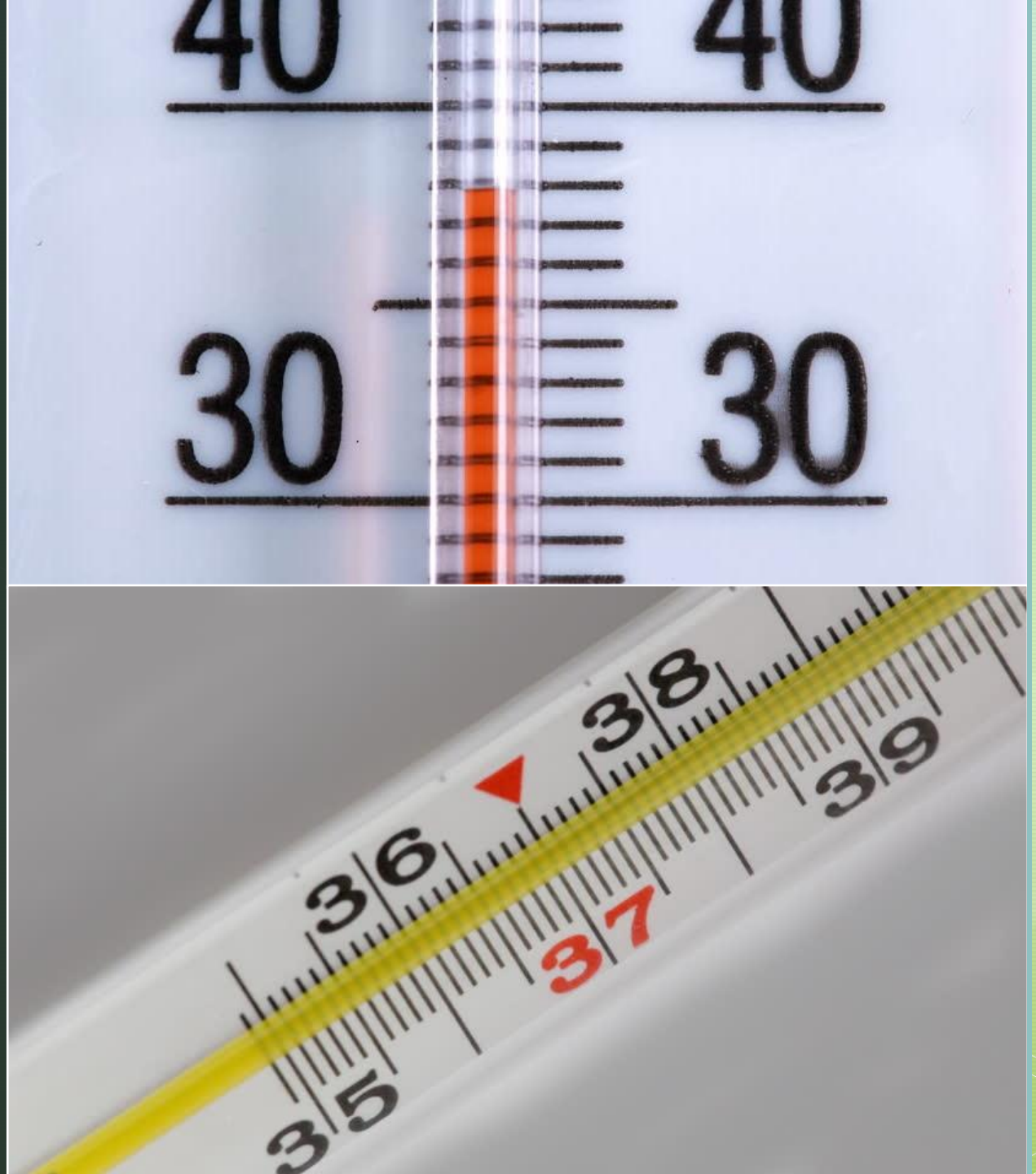


When is it close enough?



## How do you report?

- Standard must be more accurate than normal reported reading
- Can not report more information than you have



# Do not report Precision

- Sensor  $\pm 2.2^{\circ}\text{C}$
- Meter Resolution  $\pm 0.1^{\circ}\text{C}$
- Meter Accuracy  $\pm 0.1\% + 0.7^{\circ}\text{C}$
- Each degree of Ambient Temperature above  $28^{\circ}\text{C}$  or below  $18^{\circ}\text{C}$  add  $0.01\% + 0.03^{\circ}\text{C}$





# Benchtop Turbidimeter



	TL2300 Tungsten	TU5200 650nm
Range	0-4000NTU	0-40NTU
Resolution Readability	0.001NTU	0.0001NTU
Repeatability Precision	1% or 0.01NTU	1% or 0.002NTU
Accuracy	2% + 0.01NTU	2% + 0.01NTU

Being  
Proactive





# In 1492 Columbus Sailed the Ocean Blue

He proposed to sail west from the Canary Islands in hopes to find Japan and the riches of the East Indies.

He landed  
in the  
Bahamas!



## Steven Callahan in 1982

In January 1982, Steven Callahan set sail from the Canary Islands to solo the Columbus voyage





## Steven Callahan in 1982

- 6 days later, in the middle of the Atlantic Ocean, the boat sank
- He was left with a 5 foot life raft, 3 pounds of food, 8 pints of water, a solar still, and a makeshift spear



## Adrift : 76 Days Lost at Sea

- He had to get food and fresh water and contend with the sun and sharks
- 43 days later his raft sprung a leak that he could not patch
- He kept the boat afloat manually 33 more days, until his rescue
- Adrift on the currents, he traveled over 1800 miles





The 7 Habits of Highly Effective  
People – Stephen Covey

## #1 Habit : Be Proactive

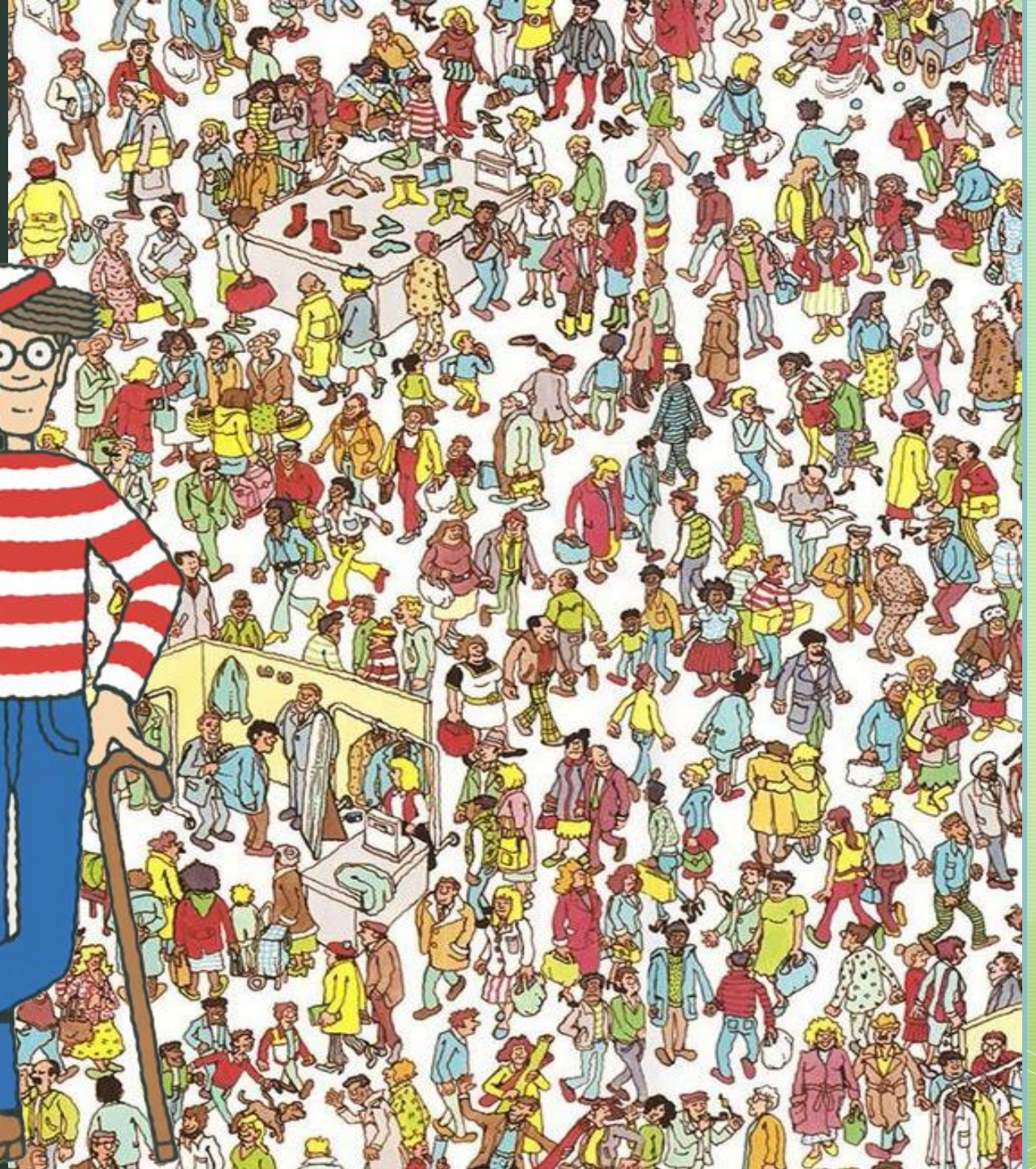
If you do **nothing** you WILL get somewhere  
(**1800** miles)

If you do **something** you WILL get closer to  
where you want to go





As Found  
vs  
As Left

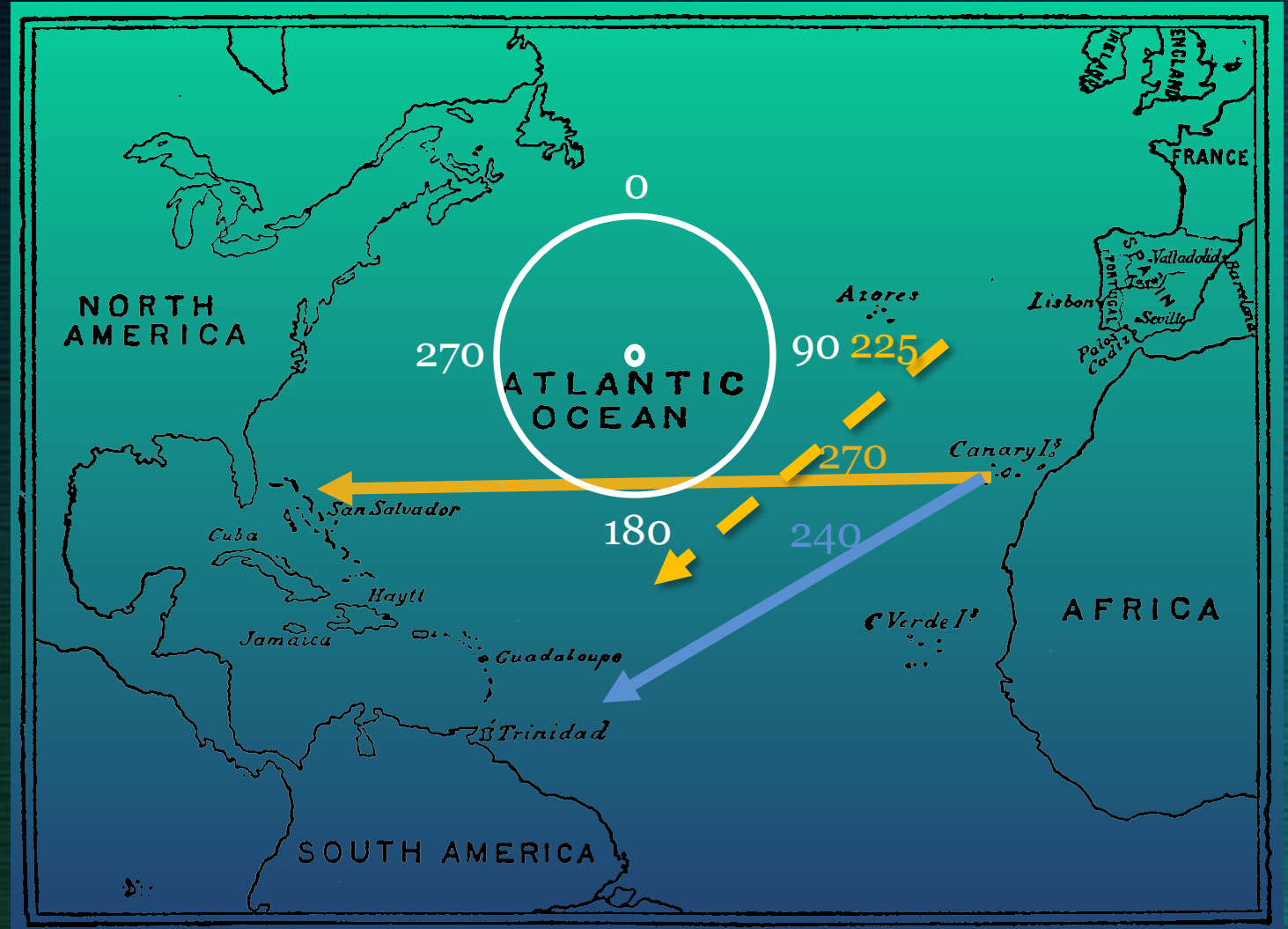




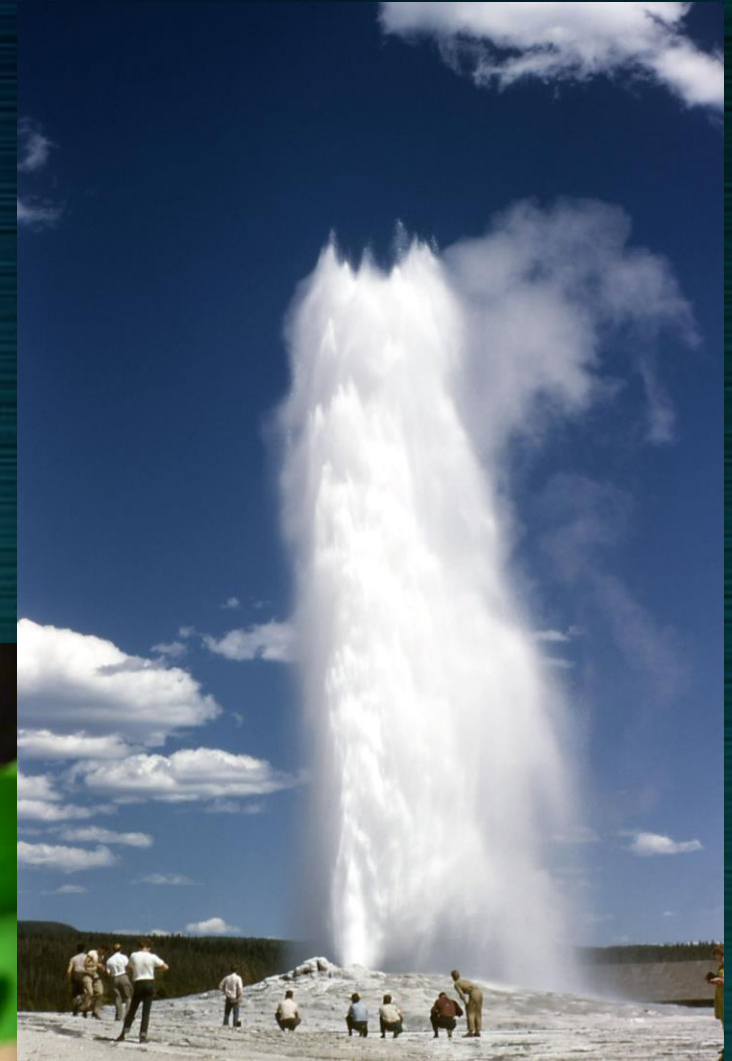
# The Basics of Navigation

If Columbus would  
have steered  $270^\circ$

He may have landed  
in Trinidad instead  
of the Bahamas



We know that  
accuracy and reliability  
of lab equipment  
drifts overtime











Vibration



Consumable Parts



Mechanical Parts



Electrical Problems



# A calibration and maintenance program

Makes course corrections

Before you drift too far

From where you want to be



Clean, Calibrate, and Perform Periodic Maintenance

AS FOUND readings  
Where you were may not be  
Where you wanted to be





The **Difference** between  
**AS FOUND** and **AS LEFT**  
Equals the **DRIFT**

**DRIFT** can help determine  
The **frequency** of calibration  
For **reliable** and **accurate** readings



# LabtronX Calibration Recommendations

Twice per year: All critical and reporting equipment

Frequent AS FOUND failures may require additional calibration or investigation into the cause of the drift.

Verification should be done regularly to ensure accuracy



Being reactive...  
dealing with  
the day to day problems,  
is just **surviving**



Instead,  
decide where you want to go  
and chart a course





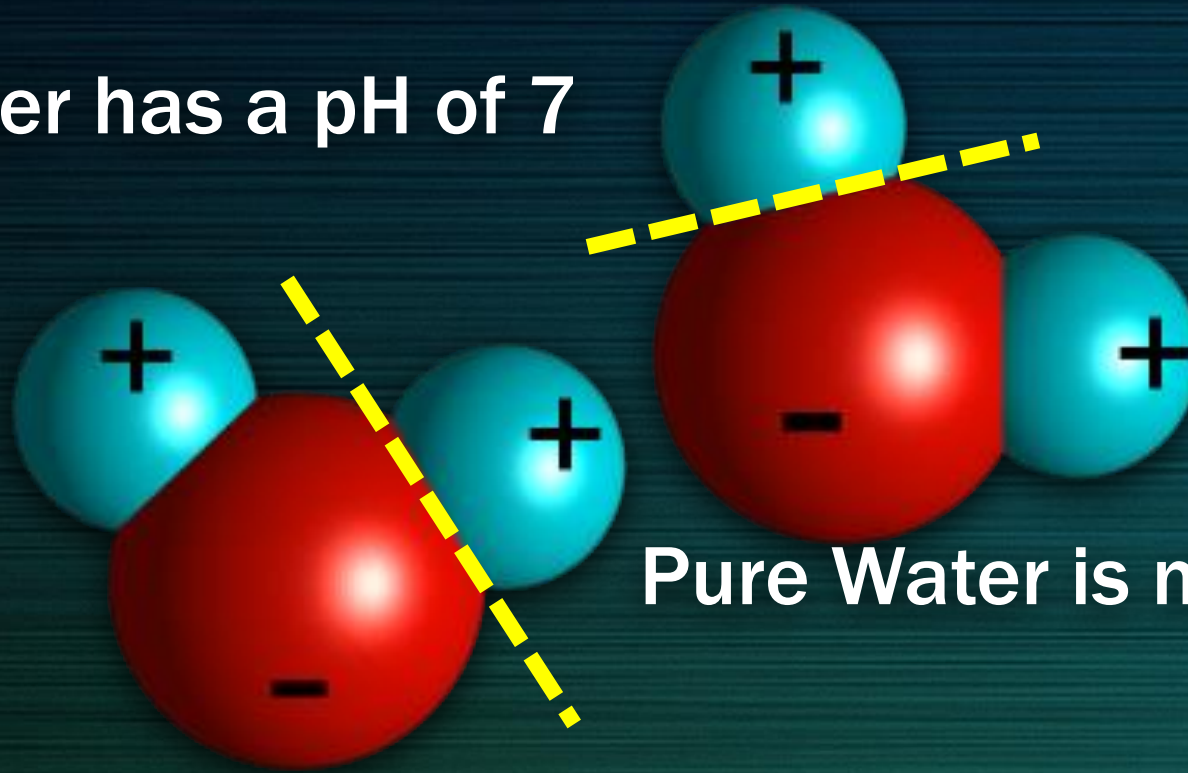
# Water





# Water is 1 Hydrogen + 1 Hydroxyl molecule.

Pure water has a pH of 7

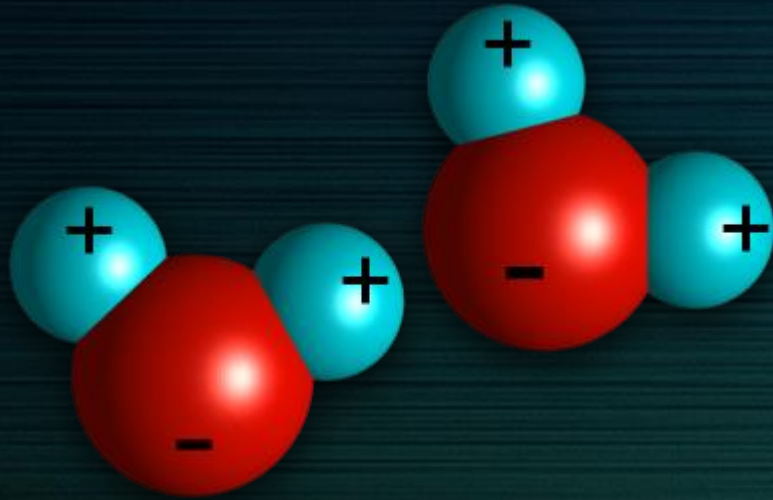


Pure Water is non-conductive

# Water dissolves everything!

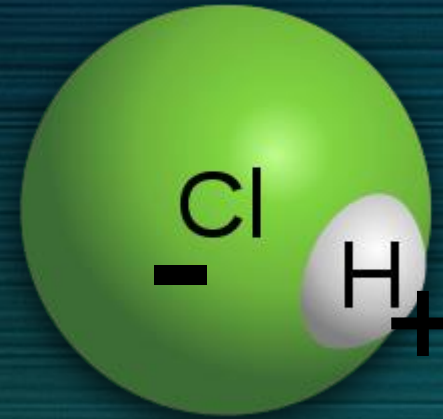


# What Happens?



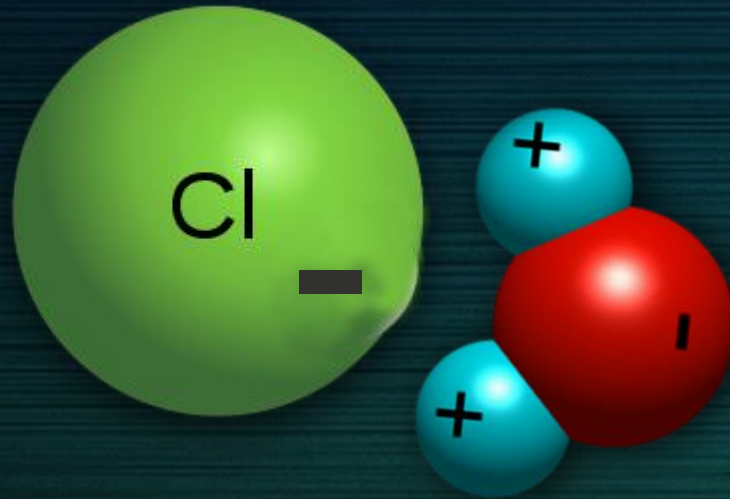
Water

+



Hydrochloric Acid

# Water Dissolves Acid



Leaves

Extra Hydrogen



1 H:1 OH = pH7  
Balanced Water

15 H:15000 OH = pH10

10 H:1 OH = pH6 The ratio of H:OH  
determines the pH of the solution.

1 H:10 OH = pH8

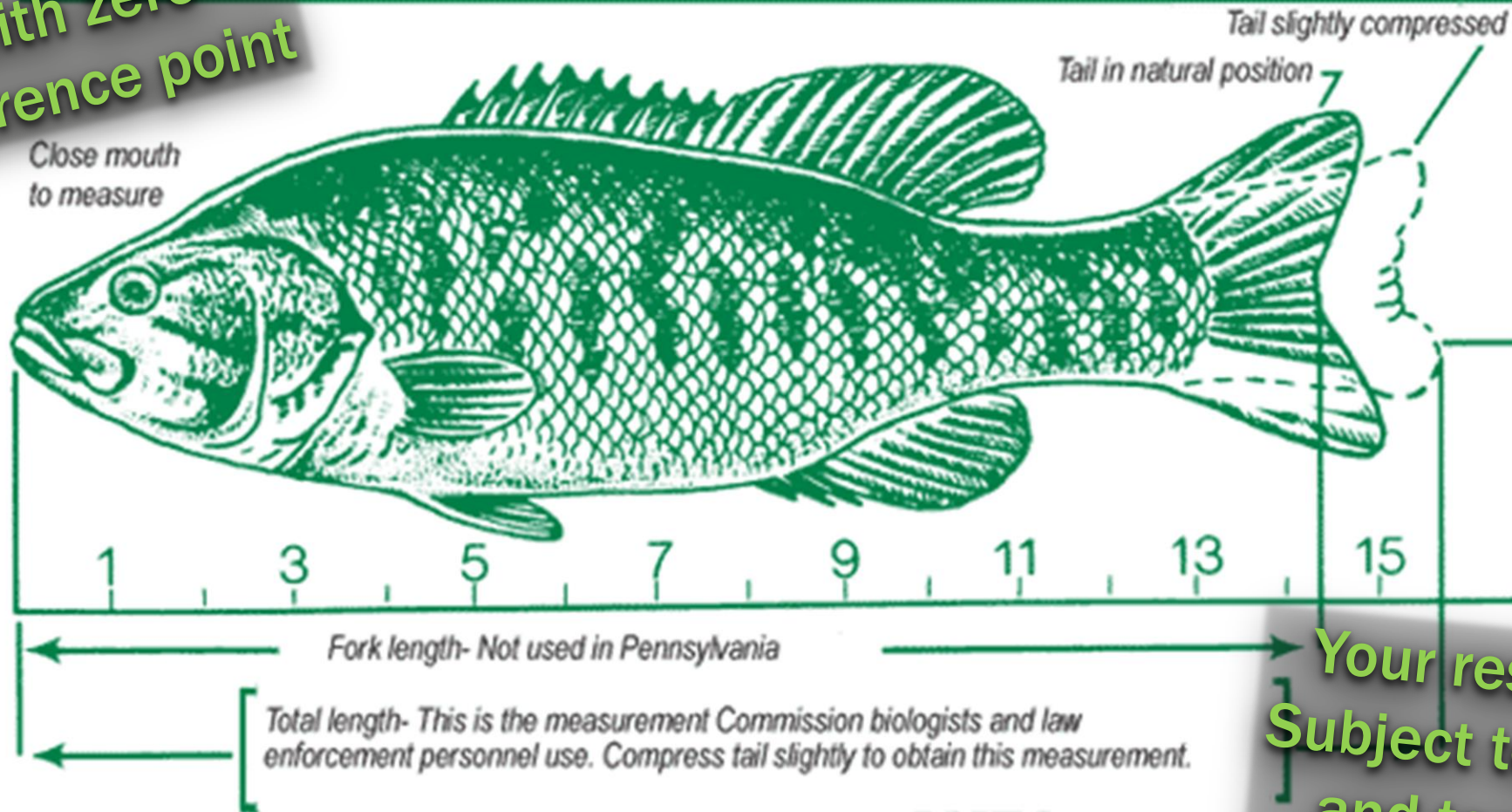
For every 10 times the number of one  
over the other  
equals one pH unit.

100 H:1000 OH = pH8

70000 H:70 OH = pH4

All measurements  
start with zero  
or a reference point

## HOW TO MEASURE A FISH

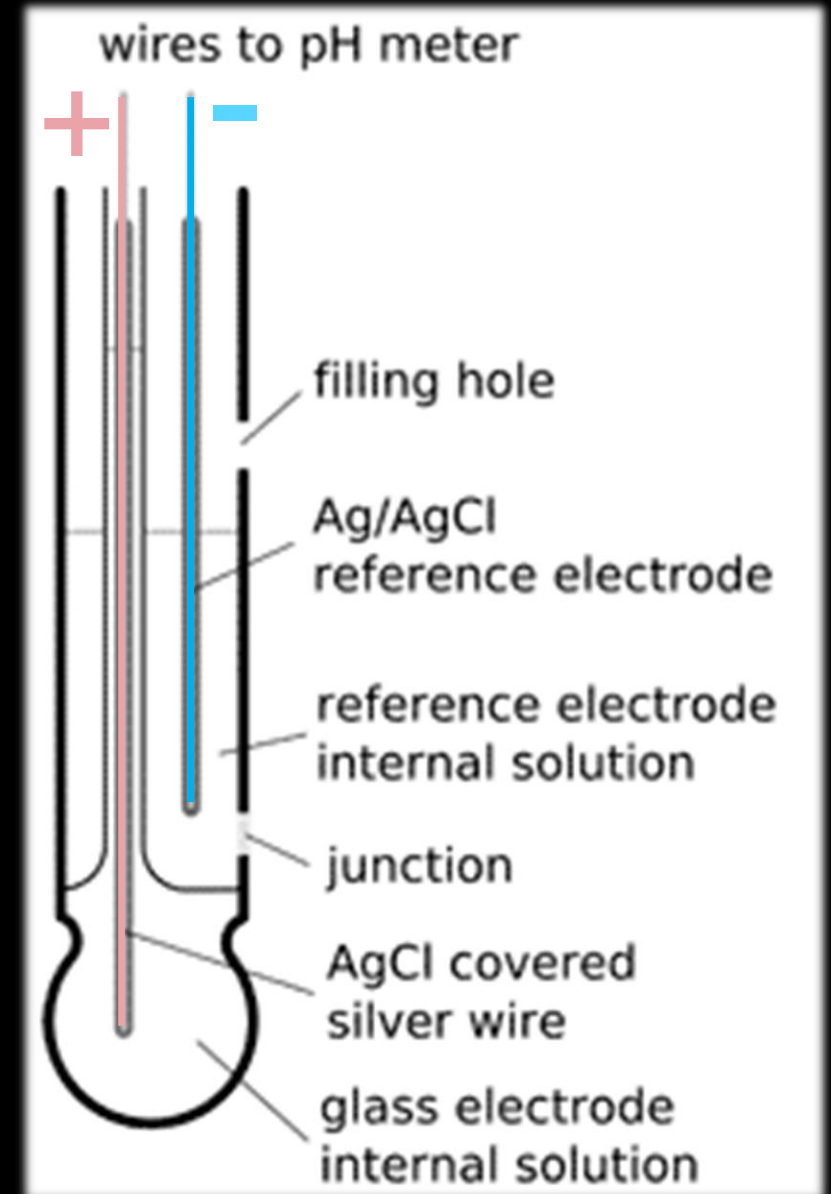


Your results are  
Subject to method  
and technique

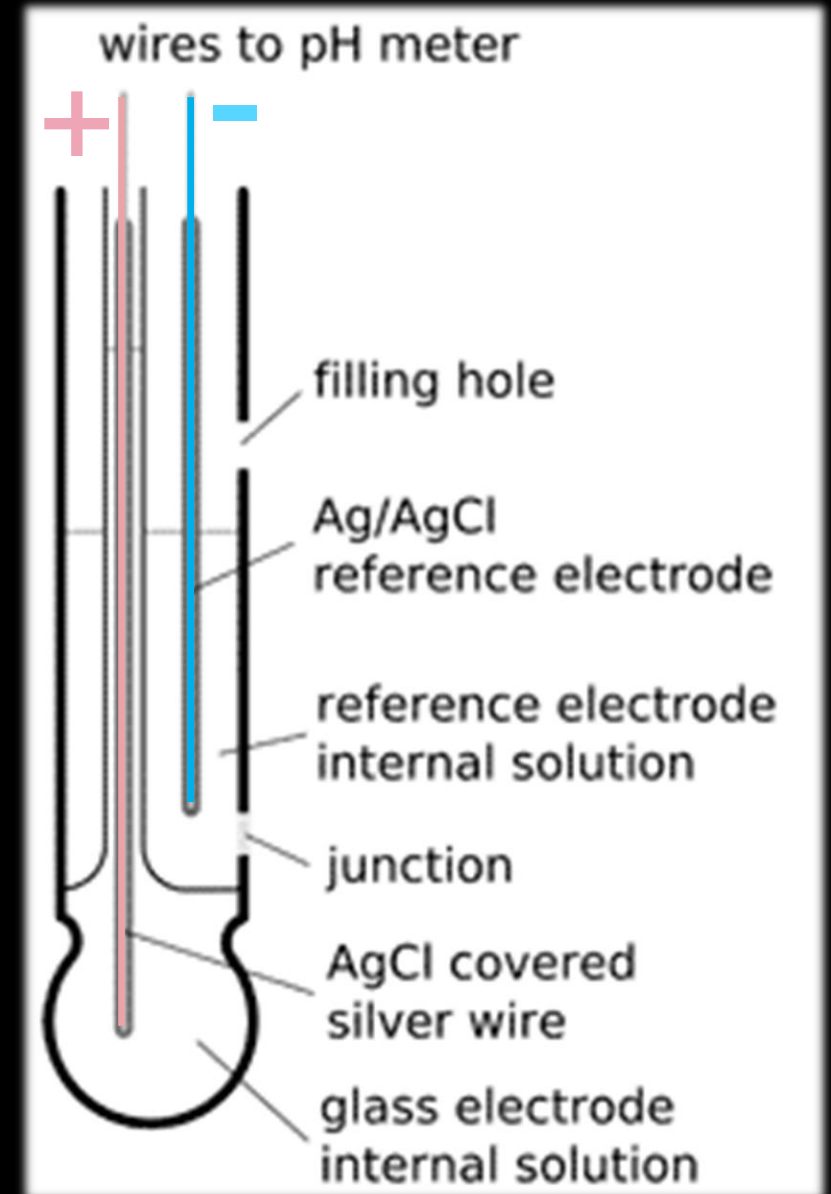


## A typical pH Electrode

- A **negative lead** (reference) behind a salt junction (the fishes Mouth)
  - a **positive lead** (pH) behind a glass membrane to read a voltage.



The pH meter reads  
positive millivolts  
when solution is **below** pH 7 (extra H)  
and  
Negative mV  
when it is **above** pH 7 (extra OH)



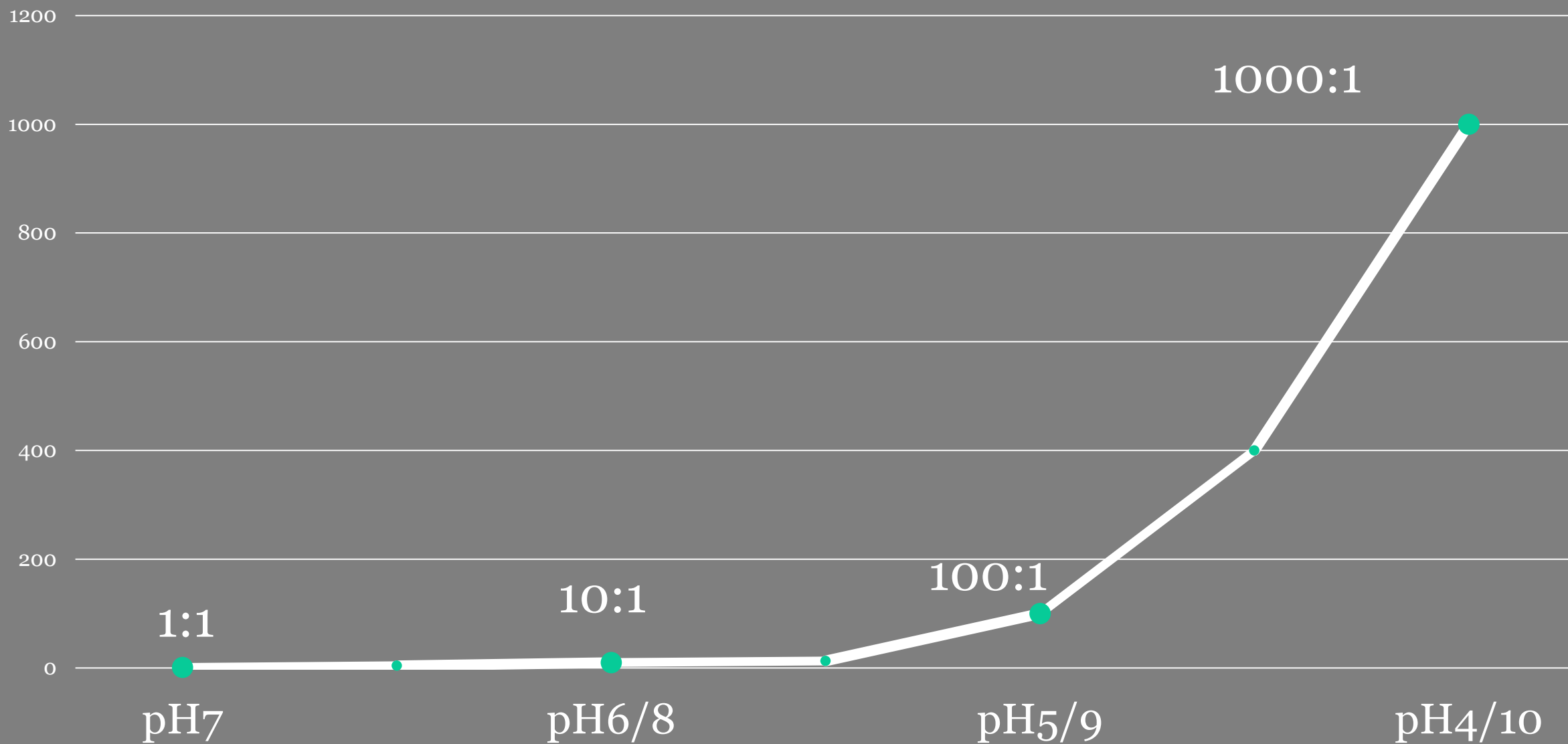


pH is  
backwards

or  
the negative log  
of Hydrogen activity

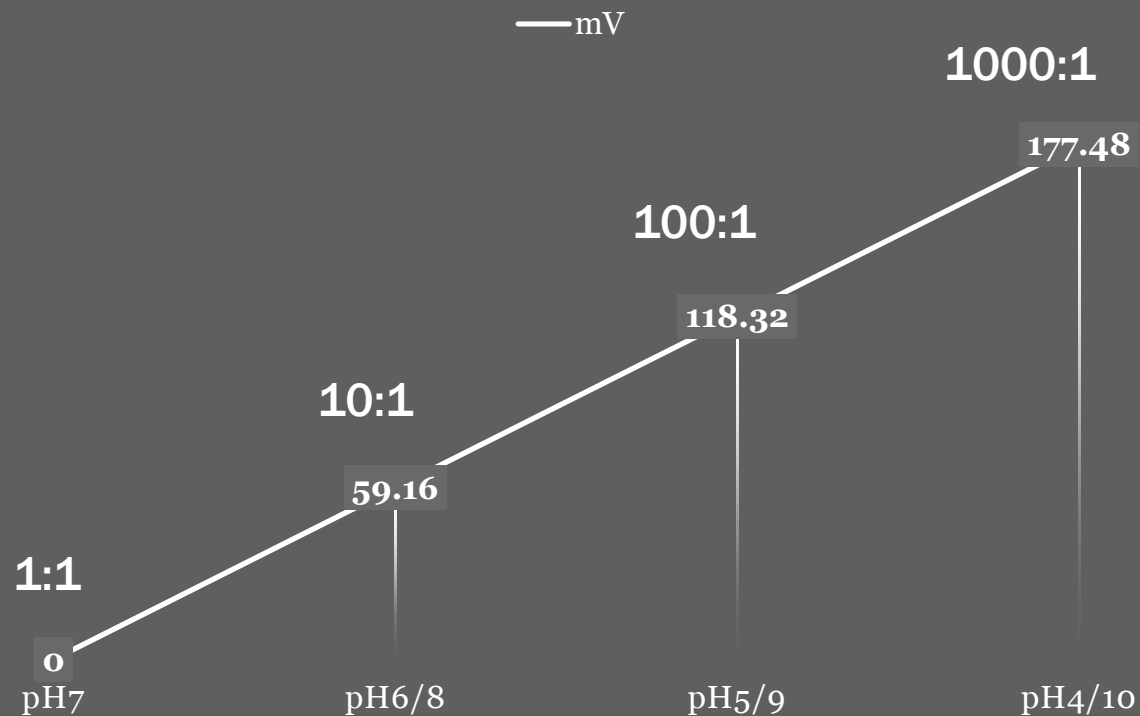


# Ratio vs. pH Curve





## SLOPE OF THE ELECTRODE



Millivolts / pH unit	% Slope
59.16mV	100%
58.57mV	99%
57.98mV	98%
57.39mV	97%
56.79mV	96%
56.20mV	95%
55.61mV	94%

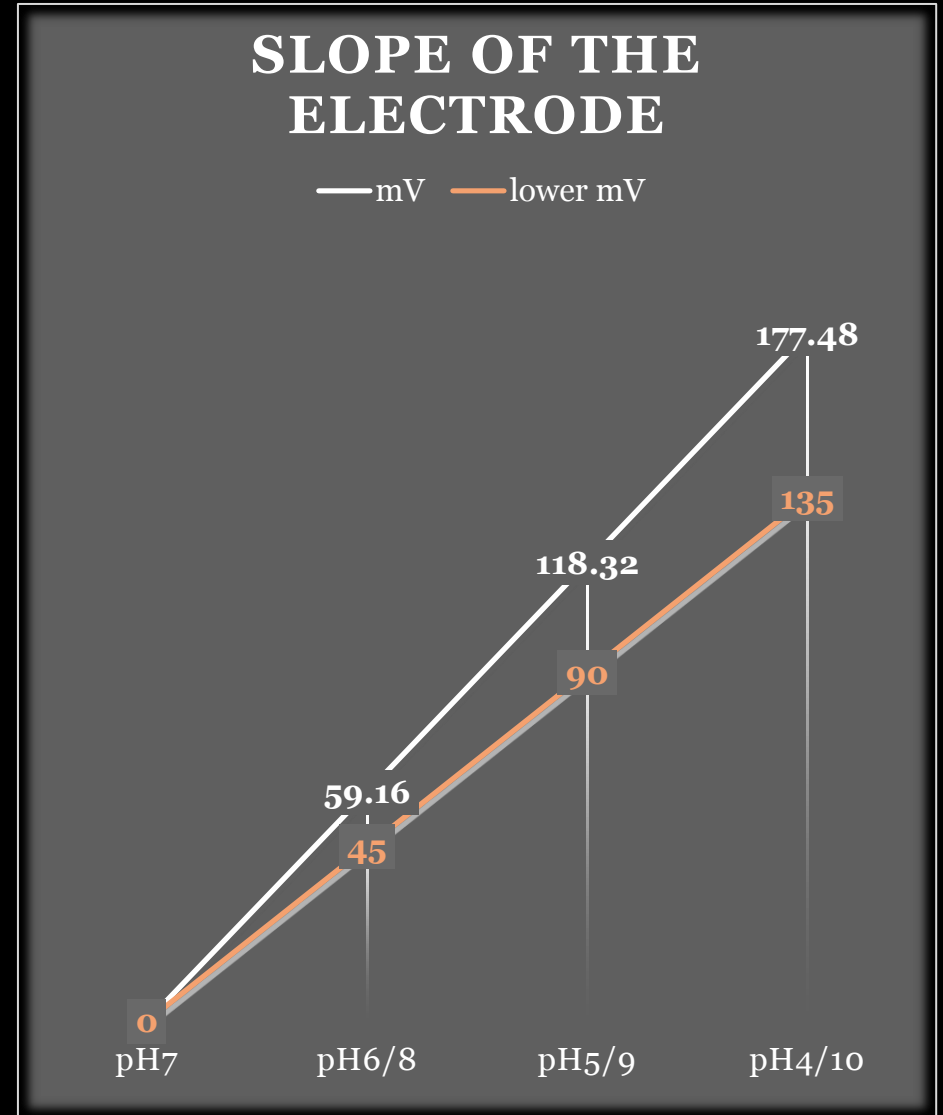
# Effects of Temperature

Temperature does not change the pH,  
only the mV output (or slope) of the electrode

ATC Probes (Automatic Temperature Compensation)  
adjust the mV reading based on the theoretical  
effect temperature should have  
on the electrode output

The further away from 7  
the more temperature compensation is needed

Triode electrodes have pH elements  
with less surface





# Calibration

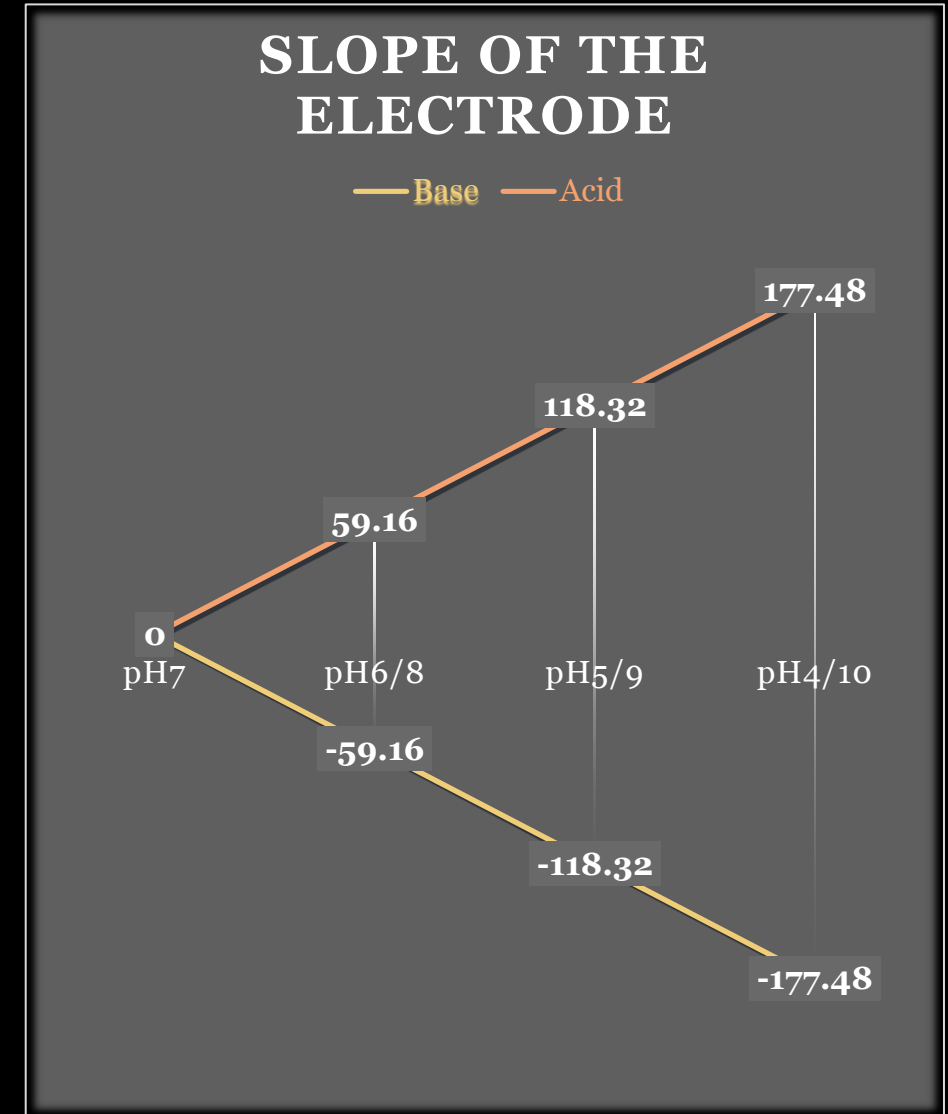
pH meters have two curves to be calibrated,  
one **positive** and one **negative**.

Calibrate with a **pH7** and at least one other buffer  
to bracket your readings (**4** or **10**)

Check expiration and open dates of buffers

Once opened, **10** Buffer often fails first

Calibrate once a day... maybe once a shift



# Electrode Health

**96% Slope is a warning**

**94% Slope is when the electrode should be changed in the water and wastewater field.**

**Look for less than 15mV offset at pH7**

**Look for quick response at stable temperatures**

Millivolts / pH unit	% Slope
59.16mV	100%
58.57mV	99%
57.98mV	98%
57.39mV	97%
56.79mV	96%
56.20mV	95%
55.61mV	94%



QUESTIONS?

LABTRONX  
(800)830-2554

