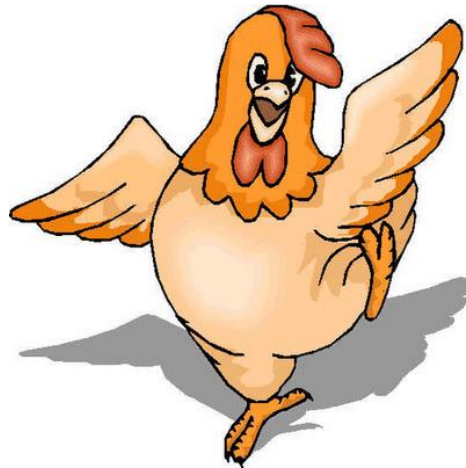


# Problem Solving

## Riddle



# Steps Scientists Use to Solve Problems:

## THE SCIENTIFIC METHOD!

1. State Problem or question
2. Gather information
3. State a hypothesis
4. Conduct Experiment
5. Observe, collect, & analyze data
6. State a conclusion
7. Repeat many times



# The Scientific Method

**Step 1:** Objective (state the problem or question)

Example: Does exercise affect pulse rate?



# Step 2: Gather information

- Study previous research in order to understand how the topic has already been explored



# Step 3: State Your Hypothesis

- Educated testable guess
- **Never a question!**
- Examples
  - Exercise will increase pulse rate.

OR

- If I exercise, then my pulse rate will increase.



# Any Testable Hypothesis is Valuable!

- **Why?**



- **Because even if it is NOT supported by the data, it can still lead to further investigation!**

# Step 4: Design & Conduct the Experiment

- Experimental Group:  
receives the treatment being tested  
(ex. participants that DO exercise)



- Control Group:  
does NOT receive the treatment tested (may receive a placebo), to be used as a comparison / baseline  
(ex. Participants that DO NOT exercise)



# Two types of variables: (components that **CHANGE** during the experiment)

## 1. Independent Variable (X-axis)

The factor that the researcher wants to test!

- ex. Amount of exercise

## 2. Dependent Variable (Y-axis)

“depends” on the original variable, is measured during data collection

- ex. Pulse rate

Constants: any factors that might affect the results, should be kept the same - ex. age, room temperature, fitness level

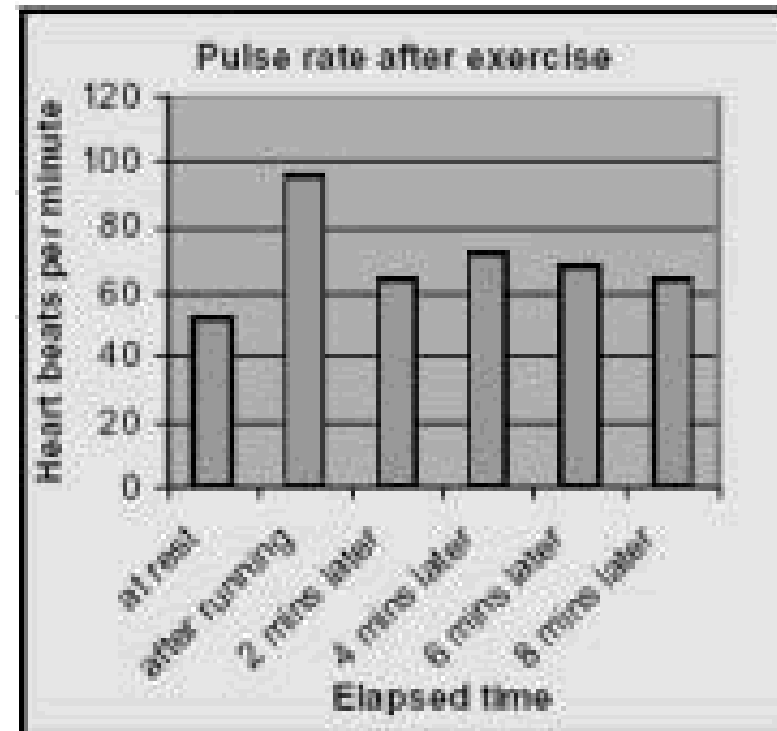


Fig. 1. A record of pupil B's heart rate

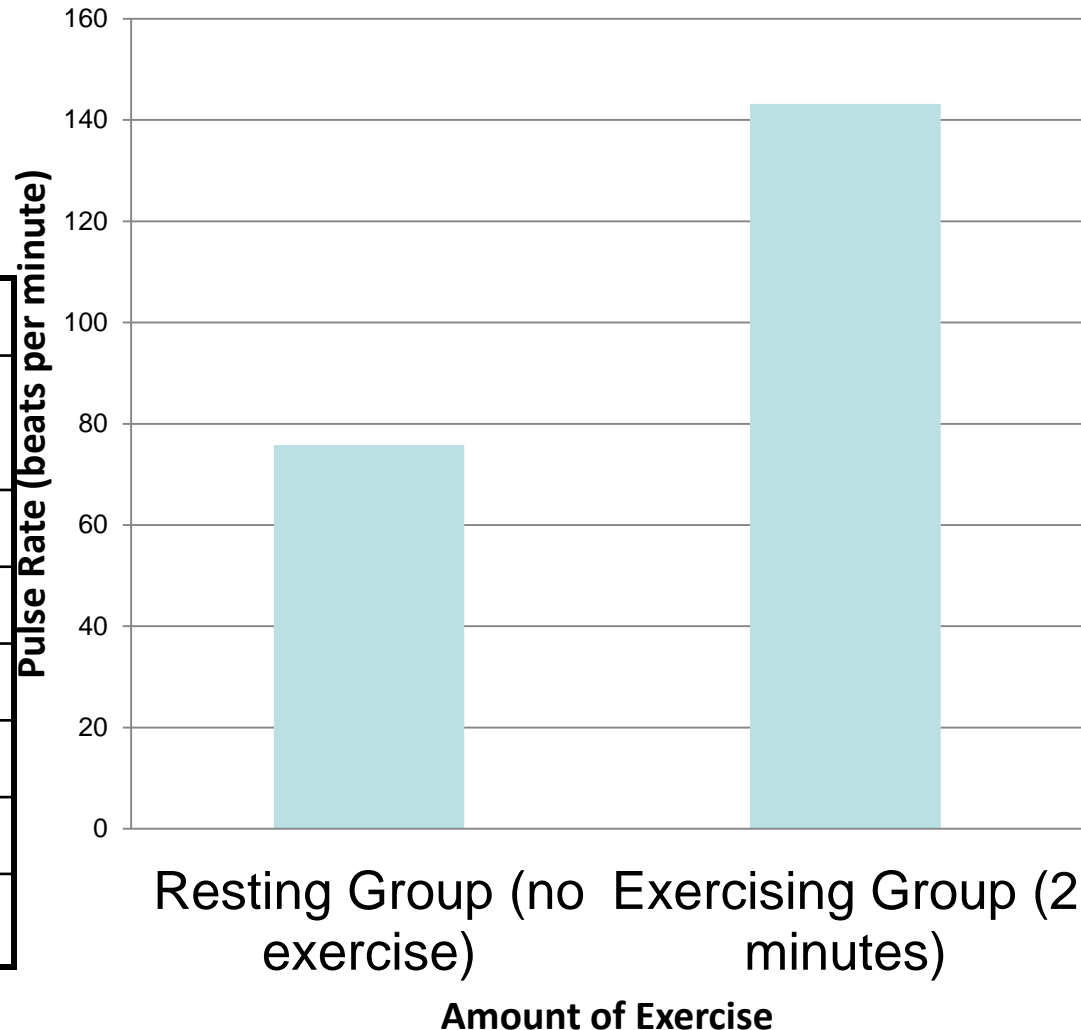


# Step 5: Collect & Organize Data

- Data tables
- Charts
- Graphs

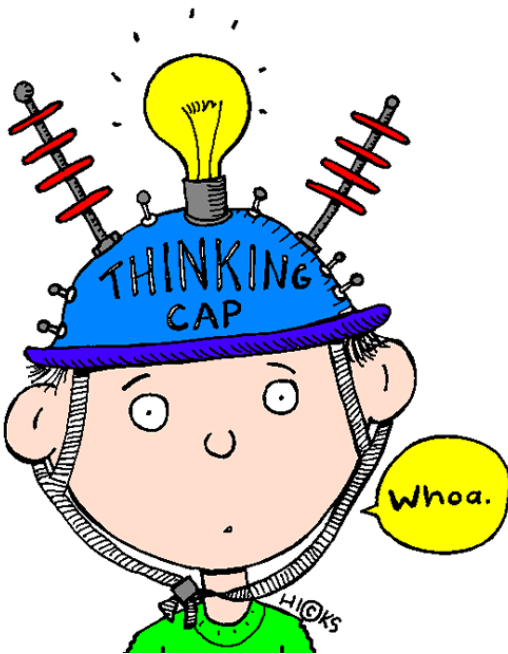
## The Effect of Exercise on Pulse Rate

Pulse rates (beats per min)		
Trial #	Resting Group	Exercising Group
Trial 1	68	128
Trial 2	72	163
Trial 3	83	145
Trial 4	81	101
Trial 5	75	179
Avg.	75.8	143.2



# Step 6: Analysis & Conclusion

- Paragraphs reflecting on the hypothesis and discussing the outcome.

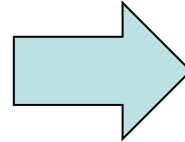
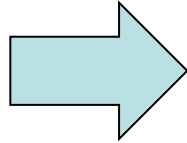


ex. The data did/did not support our hypothesis. The average pulse rates of the participants that exercised were higher, with an average of 143 beats per minute, than those of the resting group with an average of 78 bpm. This could be due to...

# Experiment Validity / Reliability

## Components of a Valid Experiment:

- Many trials
- Large sample size
- A control group (most, not all can)
- Other researchers are able to repeat it!
- Only tests 1 independent variable at a time (everything else remains constant!)



**Provide more data so averages are less influenced by outliers**



# Skittles Experiment

Problem: How many of each color Skittle are in each bag?

Gather Information:

Read the back for info, feel and count through the bag, look at the colors on the bag

Hypothesis

There are...

\_\_\_ red Skittles

\_\_\_ green Skittles...



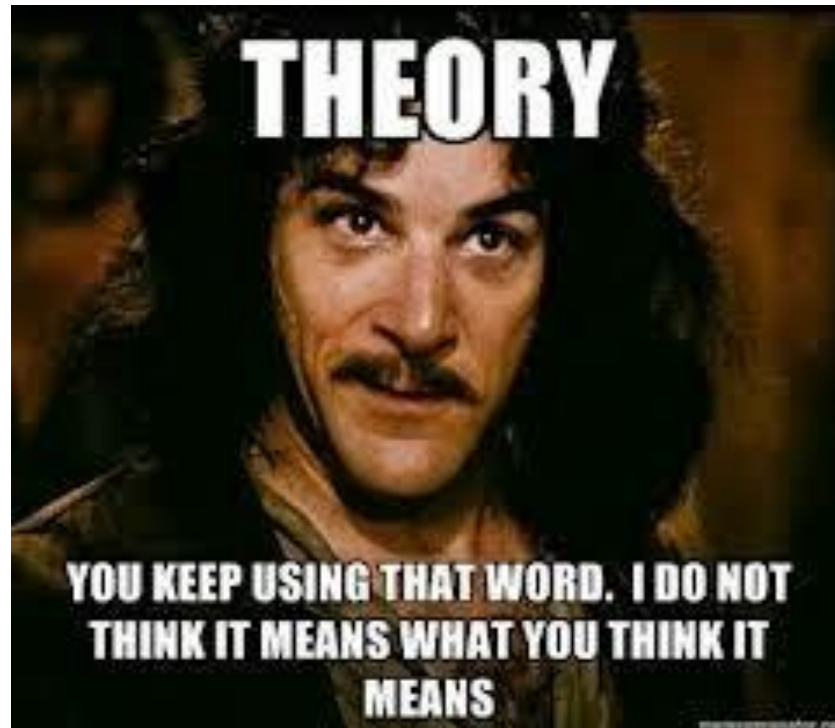
# What was missing from this experiment???

- Sample size too small! / not enough trials
- No Independent variable
- No control group (more of a 'study' than an experiment)

# How does a hypothesis become a theory?

## Theory

- a well accepted body of knowledge that has been supported by many experiments over time



# How does a theory become a scientific law?

## Scientific Law

- Always true all the time
- No exceptions
- Very rare



**Gravity.**

It's not just a good idea.  
It's the Law.

