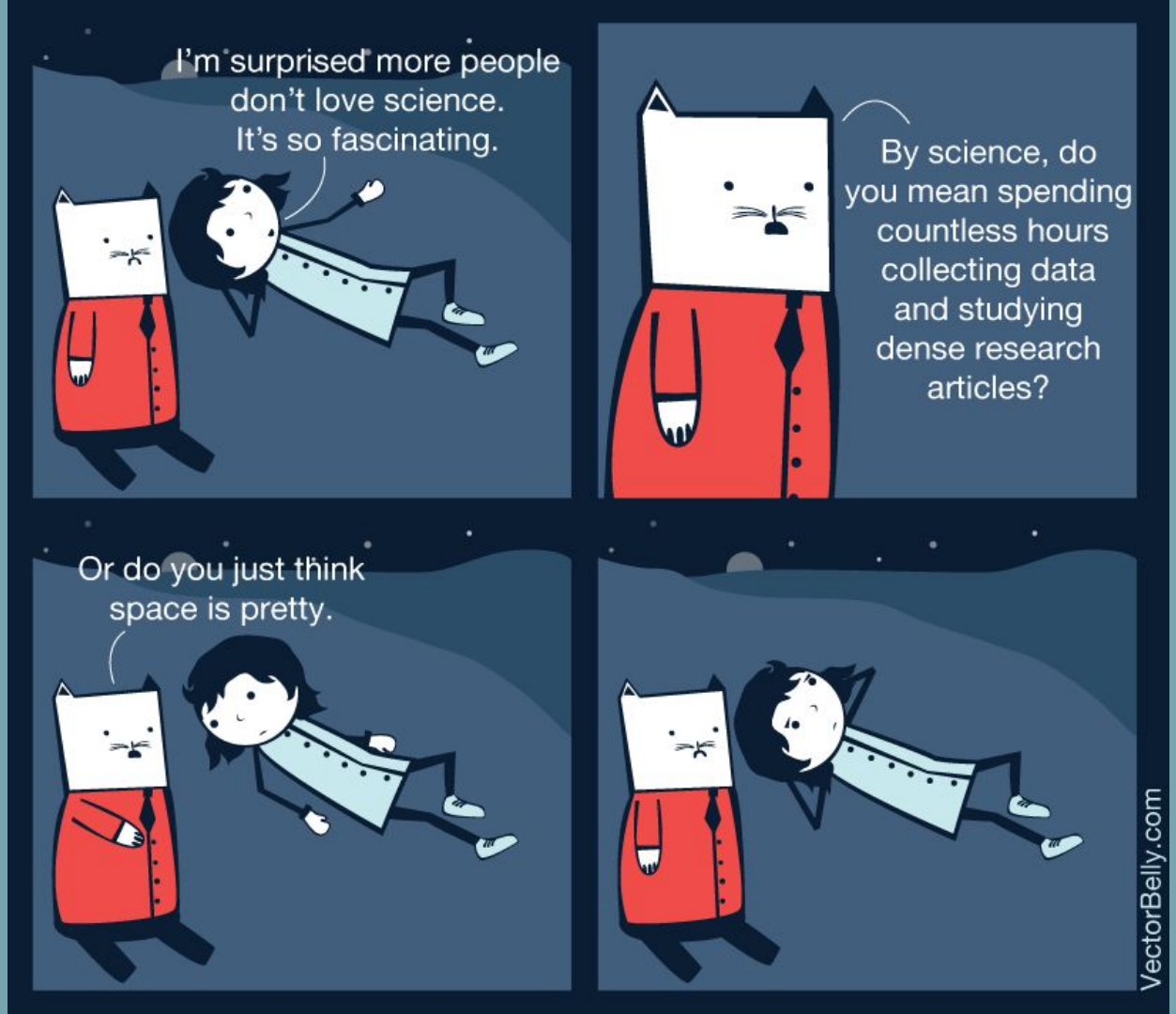
The Scientific Method

Data Study Hall 09/25/2020

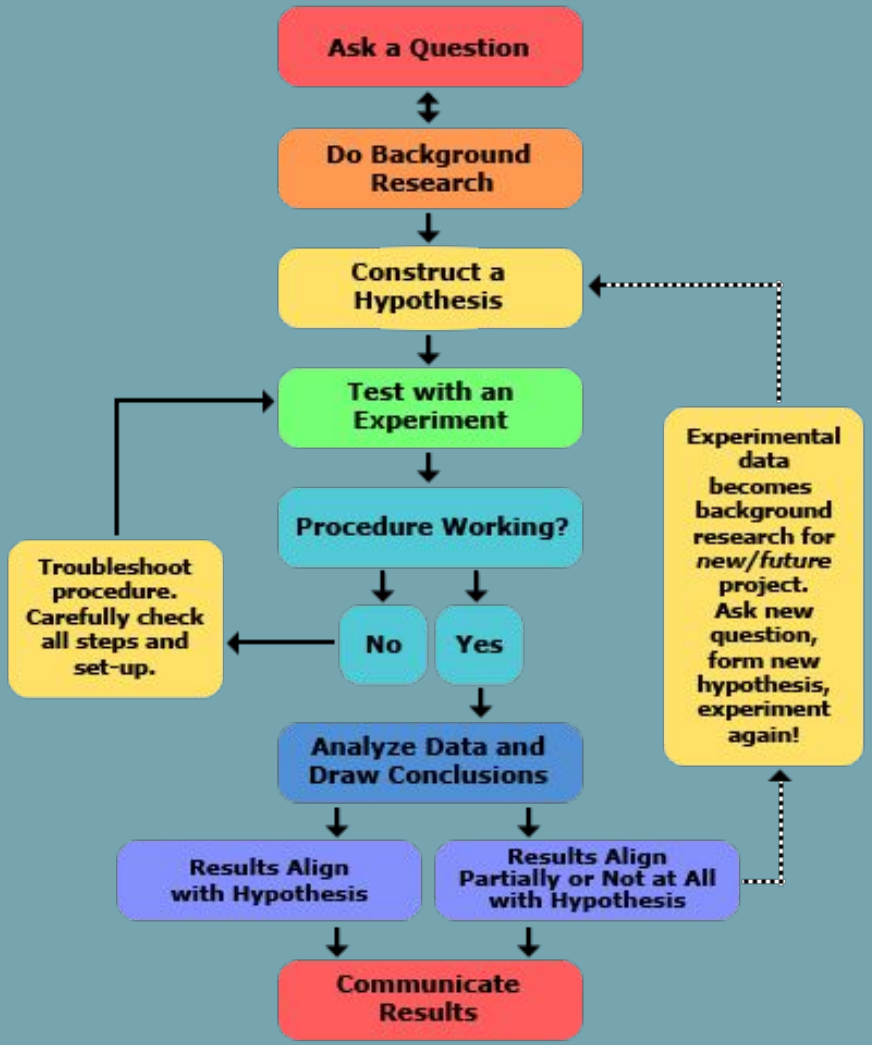
What is The Scientific Method?


I'm surprised more people don't love science. It's so fascinating.
By science, do you mean spending countless hours collecting data and studying dense research articles?
Or do you just think space is pretty.
VectorBelly.com

The Scientific Method is an empirical, methodological approach to learning about the natural world. The method involves inductive reasoning, observation, and experimentation of falsifiable ideas to generate and refine knowledge.

Steps of the Scientific Method:

1. Define a question
2. Conduct research
3. Generate hypotheses
4. Experimentation
5. Analyze data


Ask a Question
Do Background Research
Construct a Hypothesis
Test with an Experiment
Procedure Working?
No
Yes
Troubleshoot procedure. Carefully check all steps and set-up.
Analyze Data and Draw Conclusions
Results Align with Hypothesis
Results Align Partially or Not at All with Hypothesis
Communicate Results
Experimental data becomes background research for *new/future* project. Ask new question, form new hypothesis, experiment again!

Hypothesis Testing

Understanding the Hypothesis

The goal of hypothesis testing to define statistically significant aberrations in data that would reject the null hypothesis.

- H_0 = Null Hypothesis
- H_A = The Alternative Hypothesis

Tools of Statistical Hypothesis Testing

- Distribution Analysis
- Mean
- Variance
- Standard Deviation
- P-Values
- T-Test
- Coefficient of Determination (r^2)
- ANOVA Test

Computing the *p*-value

P-Value

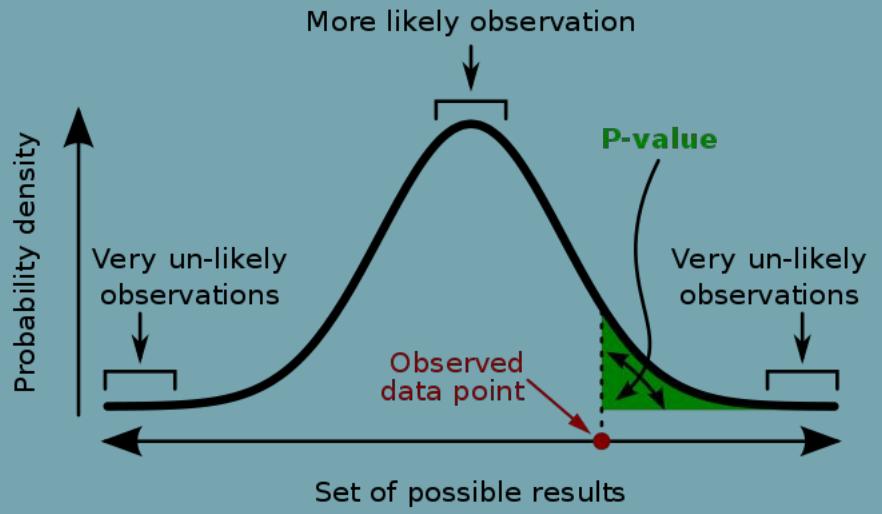
The *p*-value represents the probability of achieving the observed results of an experiment given the assumption that the null hypothesis is correct.

Important:

Pr (observation | hypothesis) ≠ Pr (hypothesis | observation)

The probability of observing a result given that some hypothesis is true is *not equivalent* to the probability that a hypothesis is true given that some result has been observed.

Using the p-value as a "score" is committing an egregious logical error: **the transposed conditional fallacy.**



A **p-value** (shaded green area) is the probability of an observed (or more extreme) result assuming that the null hypothesis is true.