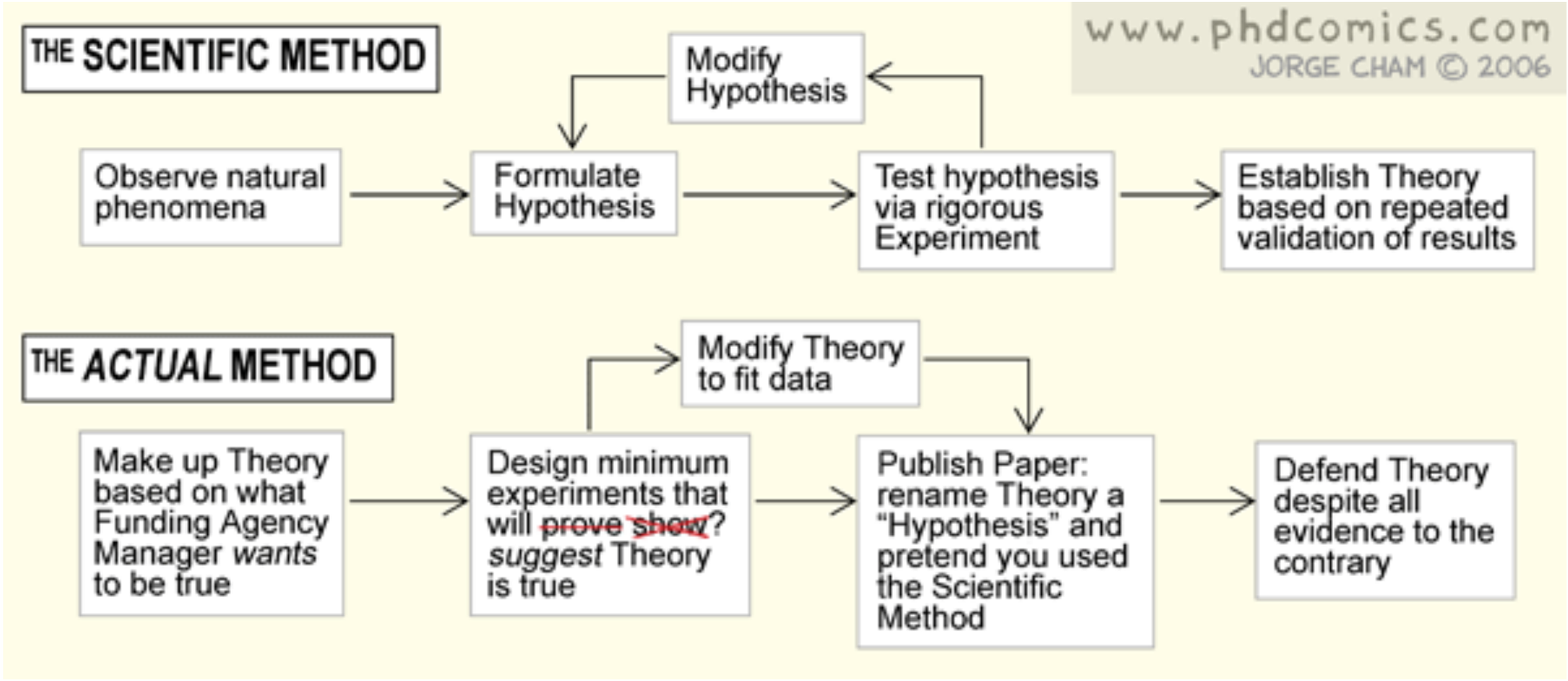
# Scientific Method 101

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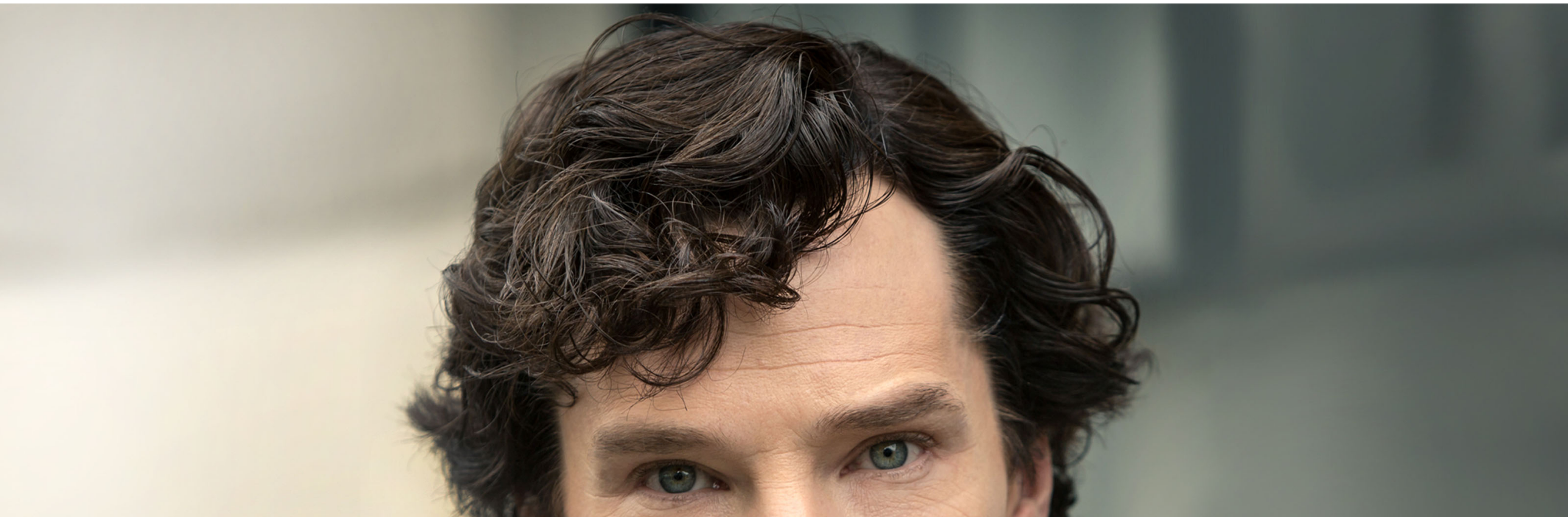
# Revisiting School Science Projects

(courtesy sciencemadesimple.com)

- Model Kit
- Demonstration
- Investigation



# Choosing Research Topic: Be Specific

I want to research in botany.

You notice that some tomatoes are bigger than others. Some grow faster.

**Question:** Why are some tomatoes bigger than others?

# Choosing Research Topic: Pick One Variable

How does size of tomatoes vary with water, sunshine, soil.

Does amount of sunlight affect size of tomatoes?

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How does size of tomatoes vary with water, sunshine, soil.

Does amount of sunlight affect size of tomatoes?

# Choosing Research Topic: Close-ended Question

How to best train your dog?

Does the type of reward affect the ability of dog to be trained?

# Scientific Method

1. **Observation:**
    1. Some tomatoes are bigger. You look up internet. What kind of visualisation will you search for?
    2. Question: Does amount of sunlight affect tomato size?
2. **Hypothesis:**
    1. More the sunlight -> More the tomato size
    2. Backed by intuition/prelim. observation
3. **Experiment/Test Hypothesis:** Two groups of tomato plants. One in sunshine, other in shade…
4. **Conclusions:** Experiments support our hypothesis that plants that receive more sunshine can grow up to x% bigger

# Experiment Design

| | Group #1 | Group #2 |
|---|---|---|
| |  |  |
| Initial Size | 0 | 0 |
| Soil | S1 | S1 |
| Water | W1 | W1 |
| Sunlight | L1 | L2!=L1 |

# Variables

1. **Independent Variable:**
    1. The variable that we modify to observe effect
    2. Amount of sunlight in our case
2. **Dependent Variable:**
    1. Variable we wish to observe
    2. Tomato size in our case

# Exercise #1 (10 minutes)

Think of some everyday thing around you and fill in the steps of the scientific method.

1. Observation
2. Hypothesis
3. Experiment/Test Hypothesis
4. Conclusions

# Exercise #2 (10 minutes)

Movie recommendation problem.

| User/ Movie | M1 | M2 | M3 |
|---|---|---|---|
| U1 | 4 | - | 2 |
| U2 | 3 | 1 | - |
| U3 | - | 1 | 2 |
| U4 | 4 | - | - |

| User | Age | Gender |
|---|---|---|
| U1 | 23 | M |
| U2 | 33 | F |
| U3 | 21 | M |
| U4 | 40 | F |

Consider the baseline: Randomly predict a rating between 0 and 5. Can you do create a research plan to better it?

# Exercise #2- Possible hypothesis

1. People tend to give similar rating across movies. Predict rating by averaging user ratings.
2. Movies tend to get similar ratings. Predict rating by averaging movie ratings.
3. Similar users have similar rating preferences. Predict rating of movie by finding rating given by most similar user.
4. …..

# Exercise #3 (10 minutes)

Think of a CS/ECE/Maths problem you want to solve in your PhD. Fill the following.

1. Observation
2. Hypothesis
3. Experiment/Test Hypothesis
4. Conclusions

Write paper abstract

1. Context
2. Motivation
3. Prior art
4. Approach
5. Evaluation
6. Results
7. Conclusions