Guiding questions
1. Step: Build mechanistic model
- What variable(s) influence y?
- In what way? Linear/non-linear?
- How much? e.g. effect sizes
- How consistent? e.g. variance, background noise (error term)

2. Step: Generate fake data and plot
- *Does this match your predictions?*
- *Is this a reasonable hypothesis?*

3. Step: Explore and play
- Enough statistical power?
- Is the model appropriate, assumptions?
- Alternative models?

Cognitive biases
e.g. confirmation bias

Knowledge gap

Research question

Scientific Knowledge/Literature

Publication bias
e.g. selective reporting,
only significant results

3. Model check & power analysis
Explore potential and limitations:
manipulate and play with
parameter settings

2. Simulation & Visualization
Data simulation:
Set sample size and x values
Generate y-values from the model.

Descriptive/conceptual
hypothesis

Overconfident,
yes/no simplification

1. Mechanistic model
Convert hypothesis into
a mathematical formula
Set model parameters

Not meaningful/testable (vague, subjective,
unrealistic, multidirectional or without
direction), i.e. the null hypothesis gets
rejected in all cases

Conclusion

Experiment/
empirical data gathering

HARKing

(hypothesizing after the results are known)

Poor design, limited sample size

Stats/Analysis

p-hacking
Garden of the forking paths

Mathematical artefact
e.g. regression to the mean