

Scientific Method

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How Knowledge is Made

Scientific Method:

- **formulating questions**
- **collecting data**
- *and* **testing hypotheses**

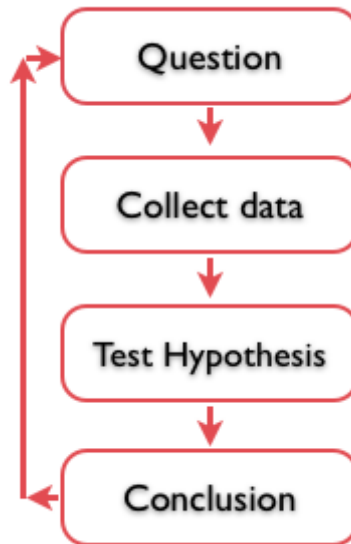
A short definition based on Merriam-Webster (2012)



The banner features the Explorable logo at the top center, with the text "EXPLORABLE" in a large, bold, sans-serif font and "Quiz Time!" in a smaller, cursive font below it. Below the logo are three square images, each with a caption underneath. The first image shows a pair of red roller skates on a wooden deck, with the caption "Quiz: Psychology 101 Part 2". The second image shows a fan of colorful pencils, also with the caption "Quiz: Psychology 101 Part 2". The third image shows a Ferris wheel at sunset, with the caption "Quiz: Flags in Europe". To the right of these images is a link that says "See all quizzes =>".

Steps

The steps ^[1] of research by the scientific method can be summarized like this:



1. Formulate a Question

- a. Define the Question
- b. Review the Literature
- c. Create a Hypothesis

Research starts with a question or assumption you have on a real world phenomenon. Narrow it down to a research question that defines what you want to figure out and review the research and literature already done on that subject. With an understanding of your subject and a well defined question you form an hypothesis [2] that will be tested against an opposite assumption called the null hypothesis [3].

- How to define a research problem [4]
- How to formulate your research question for a paper [5]
- How to write a Hypothesis for your paper [6]

2. Collect Data

- a. Preparation: Make Hypothesis Testable (Operationalization)
- b. Preparation: Design the Study
- c. Conduct the Experiment or Observation

Operationalize [7] the hypothesis to be both testable [8] and falsifiable [9]. Then design [10] a study and construct a test [10] or experiment [11] to collect data. Be aware of validity [12] when choosing variables, especially when studying people. You might not be measuring what you think you are measuring. Qualitative studies [13] tends to have more open questions and hypotheses while quantitative research [14] have an experimental [15] approach focusing more on counting and classifying observations.

- How to write the methodology [16] you used to gather data for your paper.
- How to make scientific observations [17]

3. Test Hypothesis

- a. Organize the Data
- b. Analyse the Results
- c. Check if the Results Support your Hypothesis

Organize the data and analyze it to see if it supports or rejects your hypothesis. The exact type of test ^[18] used depends upon many things, including the field, the type of data and sample size ^[19], among other things. The vast majority of scientific research is ultimately tested ^[18] by statistical methods, all giving a degree of confidence in the results.

- How to test an hypothesis ^[20]
- How to write the results in your paper ^[21]

4. Conclusion

- a. Look for Other Possible Explanations
- b. Generalize to the Real World
- c. Suggestions to Further Research

When looking at your results it is important to be open for other possible explanations. Could the results you got be generalized ^[22] to the real world? Maybe other variables ^[23] explain the question better than the ones you chose for your hypothesis? Remember to consider experimental errors ^[24] and problems with validity and reliability ^[25] in your conclusion. If your assumption on what you studied was right and your hypothesis was supported by the test, you could consider if it fits in a bigger picture with other research that together could form a theory ^[26]. If the hypothesis failed you could try to tweak it or make a new hypothesis, corrected with your newly analysed results and test again. Often the conclusion will lead you on to further hypotheses about the phenomenon that suggest a direction for more research by yourself or other scientists.

- How to draw conclusions ^[27]
- How to scientifically write your conclusion ^[28]

"Science is a verb"

"Homeopaths gets on my nerves with the old; - 'well, science doesn't know everything' ... Science knows it doesn't know everything ... or it'd stop."

Dara O'Briain

You might have come across the expression «science is a verb». This expression is an answer to the misconception of some people that science is merely accumulation of static knowledge. But what we consider to be knowledge is under constant review and sometimes it changes. Science as a method of research make all theories subject to change with discovery of new evidence. New evidence create new explanations of phenomena, or substanciate the

old theories and make us increasingly sure of their soundness.

Why use the Scientific Method?

The scientific method [31] is a standard on how to do research [29] that aims to discover new knowledge. Research in the broadest sense [30] of the word includes any gathering of data, information and facts for the advancement of knowledge, but doing science restricts the research to a method that is focused on getting accurate and, most often, narrow conclusions.

Relevant pages:

What is Research? [29]

How to define Research? [30]

Having done research by the scientific method makes it transparent and explorable. All published results from this method is reviewed by scientists against other findings or explanations to see if it is valid [12], or retested [32] to see if the results were reliable [33]. This is why publishing and review [34] of research is such a big deal for scientists.

“Somewhere, something incredible is waiting to be known.” (Carl Sagan)

Source URL: <https://explorable.com/scientific-method>

Links

- [1] <https://explorable.com/steps-of-the-scientific-method>
- [2] <https://explorable.com/research-hypothesis>
- [3] <https://explorable.com/null-hypothesis>
- [4] <https://explorable.com/defining-a-research-problem>
- [5] <https://explorable.com/research-paper-question>
- [6] <https://explorable.com/how-to-write-a-hypothesis>
- [7] <https://explorable.com/operationalization>
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- [32] <https://explorable.com/reproducibility>
- [33] <https://explorable.com/definition-of-reliability>
- [34] <https://explorable.com/peer-review-process>