

A Checklist for Conducting Experimentation

Below is a general list of considerations for conducting scientific experimentation in cybersecurity. It captures the major components of the scientific method, and other important considerations and waypoints. Science is too broad to have a universal and concrete, one-size-fits-all checklist and your experiment will almost certainly have modified or expanded steps, but this serves to guide you and help ensure that the important aspects aren't overlooked.

Formulate a question to study, the purpose for doing experimentation.

Ensure that the topic is non-trivial and important to solve.

Conduct a literature review and background research to see what is already known.

Form your hypothesis, ensuring that the statement is testable, reproducible, and falsifiable with an independent and dependent variable.

Make some predictions about your hypothesis.

Assemble a team to help execute the experiment, if necessary.

If studying human subjects, seek institutional review board (IRB) approval.

Test your hypothesis. Collect data.

- Make a list of data, equipment, and materials you will need.
- Carefully determine the procedure you will use to conduct the experiments.
- Identify the environment or test facility where you will conduct experimentation (e.g. laboratory, cloud, real-world).
- Determine the scientific and study instruments you will use.
- Identify the necessary sample size to achieve statistical power.
- Conduct your experiments.
 - Change only one variable at a time to ensure a fair test.
 - Record data and observations.
 - Check data during collection to validate that collection is working properly.

Analyze and interpret the data and test results to determine whether to accept the hypothesis.

Check for experimental errors and outliers. Are the results reasonable?

Document your experiment.

- Include a description of your procedures with enough detail for others to reproduce.
- Include details of the data, equipment, configurations, and other materials used.
- Describe the analytical technique(s) you applied and their results.
- Explain your conclusions, including why you did or did not accept the hypothesis.
- Honestly explain limitations of your data, approach, and conclusions.
- Provide considerations for future experiments or impact of your results.

Determine if you should modify your hypothesis and conduct further experimentation.

Put your results to work by publishing a paper or creating a product.

Make code and data used in experimentation publicly accessible if possible.