Research Skills

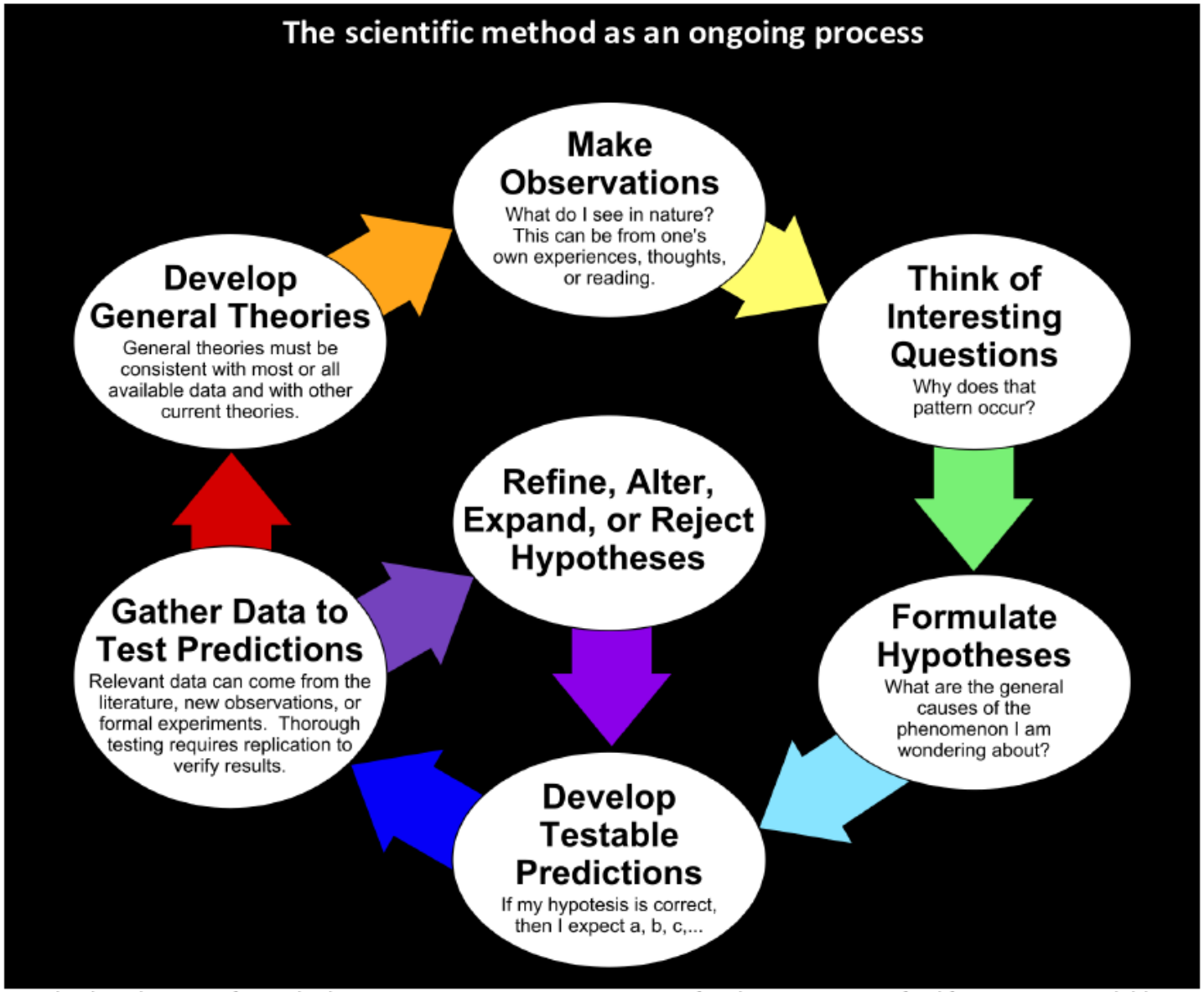
- Module 1
- The Research Framework

© Natasha Radcliffe 2018
Registered Nutritionist (NSA)
Registered Teacher (SA TRB)

Applying the Research Framework

The four parts of the research framework are:

1. initiating and planning the research
2. developing the research
3. producing and substantiating the research outcome
4. evaluating the research.



Garland, T. The scientific method as an ongoing process. Department of Biology. University of California. 2015. Available from: http://idea.ucr.edu/documents/flash/scientific_method/story.htm

The Scientific Method as an Ongoing Process

The scientific method is an ongoing, iterative process. *It usually begins with* ***observations*** *about the natural world. Human beings are naturally inquisitive, so they often come up with* ***questions*** *about things they see or hear. Some people think further and develop ideas (****hypotheses****) about why things are the way they are. The best hypotheses, from the standpoint of science, are those that lead to* ***testable predictions.*** *These predictions can be tested in a variety of ways, including making further observations to look for evidence supporting or refuting the predictions. In general, the strongest tests of hypotheses come from* ***carefully controlled and replicated experiments*** *that gather empirical* ***data****. Sometimes, mathematical or physical models are used to test predictions. Whatever methods are used to test the predictions, in an ideal world they should be* ***replicated*** *at least once. Depending on how well the tests match the predictions, the original hypothesis may require* ***refinement, alteration, expansion or even rejection****. (In general, hypotheses that cannot possibly be falsified are considered outside the realm of science.) The cycle of predict, test, refine can* ***repeat*** *many times, even indefinitely. At some point, a particular hypothesis (such as the occurrence of adaptive evolution by natural selection) may become so well supported that it leads to the development of* ***a general theory****. Any such theory must accommodate all available evidence (allowing for the possibility that some data may be erroneous), and be reasonably consistent with other theories, hypotheses, and observations about the same or related topics.*

Note that in this context a "theory" refers to a set of interrelated ideas, well-supported by evidence. General theories often unify information and theories from other disciplines.

The scientific-method is also known as the hypothetico-deductive process.

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Study Design

This issue of ***Research Bites*** looks at study design. Various designs are available depending on the kind of question/s being asked. For example, descriptive questions do not require a randomised controlled trial (RCT), but studies to evaluate a new treatment would benefit from a RCT. Resources are another factor. Cohort and RCT can take a long time to complete and are very expensive. Furthermore, RCT may not be ethically feasible.

Descriptive and analytical studies

One way of classifying study design is to divide them into descriptive studies that describe a situation or analytical studies that try to explain a situation by formulating and testing hypotheses (see Table 1).

Non-experimental and experimental studies

Studies can also be categorised as non-experimental (or observational) with no intervention or experimental where the researcher intervenes, e.g. by introducing a new treatment (see Table 1).

Main study designs (O'Donnel & Watt, 2003; Peat, 2001)

Randomised controlled trials (RCT)

- RCT are the best way to assess whether an intervention is effective.
- They are the "gold standard" of clinical trials with very strict rules on how they are conducted.

Intervention trials

- These are experimental studies designed to test cause-effect hypothesis of a researcher-led intervention.

Longitudinal studies

- These are surveys of frequency of disease, risk factors or other characteristics in a defined population *over a period of time.*
- Two types are cohort and case-control studies.

Cohort studies

- It is usually *prospective* or forward-looking.
- A cohort is a group of individuals with a shared characteristic studied over time.

Case-control studies

- This is *retrospective* or backward looking.
- They try to relate an effect or outcome to a probable cause.
- Individuals with a disease (cases) are compared to those without the disease (controls) to determine if they differ in their past exposure to a postulated causal factor.
- They are used to establish links between the exposure or risk factors and disease.

Cross-sectional studies

- These are the most common study design and are surveys of frequency of disease, risk factors or other characteristics in a defined population *at a given period of time.*
- They can be descriptive or analytical and can provide evidence of an association, but not causation.

Case study or series

- They describe interesting and unusual cases - one (study) or several (series).

Source: Study Design. Research Bites (Mar 2003). University of New South Wales. Available from:http://www.phcris.org.au/phcred/research_bites/research_bites_6.pdf

Table 1: Types of studies (adapted from O'Donnel & Watt, 2003)

Type of study	Descriptive	Analytical
Experimental		
RCT	✖	✔
Intervention trial	✖	✔
Non-experimental (or observational)		
Longitudinal	✔	✔
Cohort	✔	✔
Case-control	✔	✔
Cross-sectional	✔	✔
Case series	✔	✖
Case study	✔	✖