

GOHREP - How to plan and manage a research project

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1 General structure

Start by defining the following:

- **GOal:** Here you write your main objective; what do you want to ultimately achieve; you can be general but not too vague
- **Hypothesis:** A hypothesis is a statement of a fact, an educated guess; it is central to scientific thinking so make sure you are familiar with the concept -- <http://en.wikipedia.org/wiki/Hypothesis> ; the hypothesis needs to be specific
- **Rationale:** this is your logic for coming up with the hypothesis; describe the finding or observation that led you to make such an educated guess; typically the rationale is based on preliminary data
- **Experimental plan:** Which general approach and which specific experiments will you undertake to challenge the hypothesis with the ultimate goal of achieving your objective; note that a typical approach in science is to design experiments that aim at falsifying your hypothesis; as long as your hypothesis stands these tests then you're okay, otherwise you need a new hypothesis

In addition, but only in addition and after you defined the above, you can list a series of **specific questions that you want to address**. This can be helpful as you develop the experimental plan but it doesn't replace the GOHREP framework.

2 Example

See Dong et al. 2014, Science: http://kamounlab.dreamhosters.com/pdfs/Science_2014.pdf

- **GOal:** Understand the biochemical basis of adaptive evolution in host-specialized pathogens.
- **Hypothesis:** The apoplastic effector PmEPIC1 evolved to adapt to a *Mirabilis jalapa* protease after *Phytophthora mirabilis* diverged from *Phytophthora infestans* ~1300 years ago.
- **Rationale:** Hypothesis is based on preliminary experiments which showed that
 1. orthologous EPIC1 and PmEPIC1 from host-specific sister *Phytophthora* species have a clear signature of positive selection;
 2. Unlike its *P. infestans* ortholog EPIC1, PmEPIC1 cannot inhibit the *Solanum* Cys protease RCR3 indicating some degree of effector specialization on target proteases from their respective hosts.
- **Experimental plan:**
 1. Confirm that EPIC1 and PmEPIC1 have differential activities on various *Solanum* RCR3, particularly those from wild Mexican potatoes that are natural hosts of *P. infestans*;
 2. Identify the *M. jalapa* protease that is inhibited by PmEPIC1 and determine whether it is differentially inhibited by PmEPIC1 and EPIC1;
 3. Deduce the sequence of the ancestral EPIC1 effector and determine the activity of this predicted ancestral EPIC1 on both *Solanum* RCR3 and the targeted *M. jalapa* protease.