Scientific Method
&
Developing Grant Proposals

Dr. Charles Long
VTPP
March 1, 2010

What is a Scientist?

- A scientist is a person who **asks questions** and tries different ways to answer them.
- A scientist learns from his/her **senses**.
- A scientist **notices details**.
- A scientist **draws** what he/she sees.
- A scientist **writes** about what happens.
- A scientist makes **comparisons** by **measuring**.
- A scientist must **count exactly**.
- A scientist looks at objects carefully to **decide** how to **sort**.
- A scientist **designs experiments to test predictions**.
- A scientist experiments by **trial and error**.
- A scientist **thinks logically**.
- A scientist **keeps trying** over and over.
- A scientist has **fun**.

Barbara Lehn

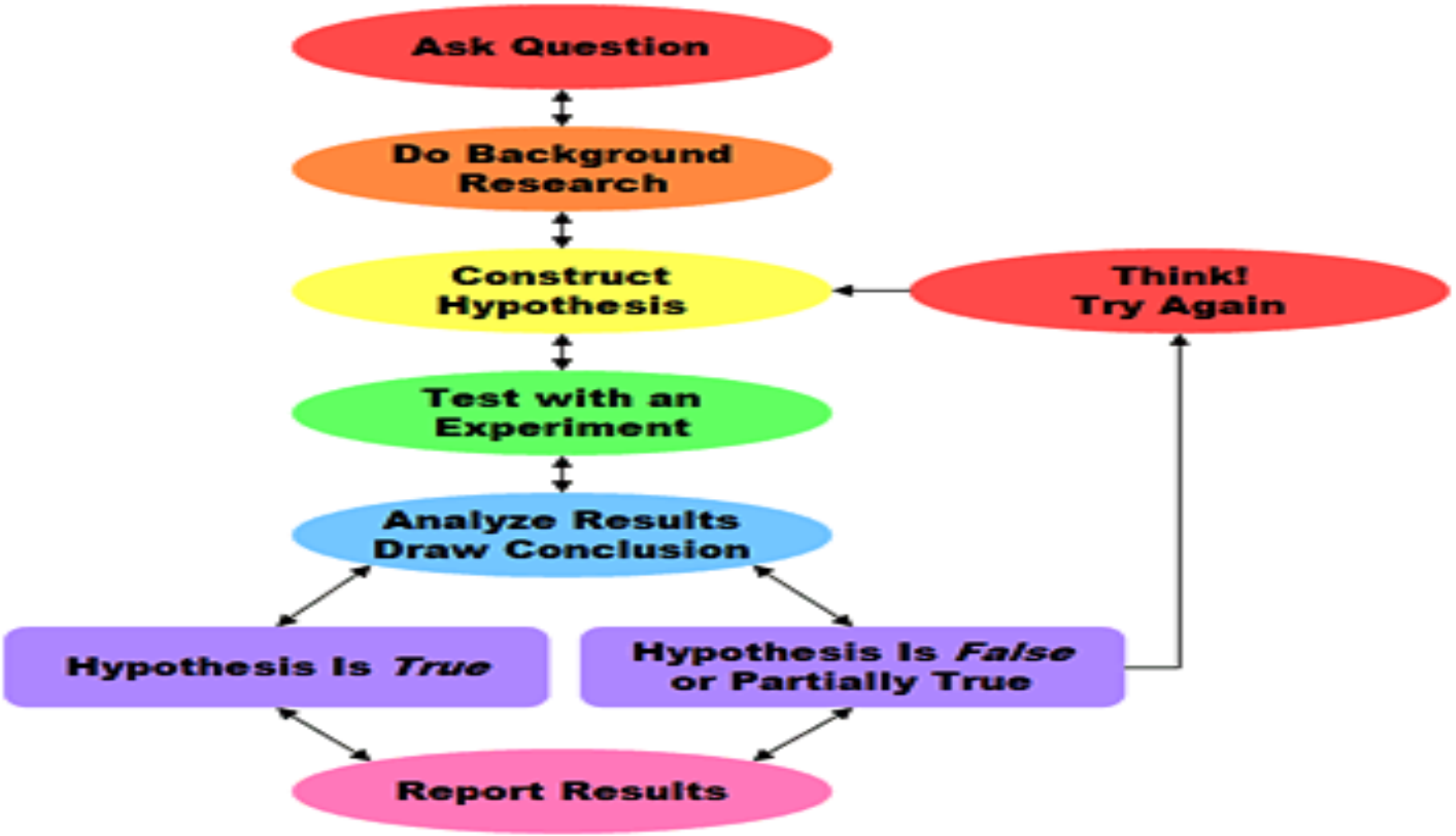
The Scientific Method and Proposal Development

The Scientific Method

- The steps of the scientific method are to:
  - **Ask a Question**
  - **Do Background Research**
  - **Construct a Hypothesis**
  - **Test Your Hypothesis by Doing an Experiment**
  - **Analyze Your Data and Draw a Conclusion**
  - **Communicate Your Results**

http://www.sciencebuddies.org/

Scientific Method Flow



Background Research

- Library
- Internet
- Advisor

- Most likely problems:
  - Information overload.
  - Information wasteland.
- How to read a scientific paper.
  - http://www.sciencebuddies.org/science-fair-projects/top_science-fair_how_to_read_a_scientific_paper.shtml

Good Hypothesis Building

- Hypothesize using your independent variable (the variable you change during your experiment) and your dependent variable (the variable you observe).
- Changes in the dependent variable depend on changes in the independent variable.
- For example: "If a particular independent variable is changed, then there is also a change in a certain dependent variable."

What Makes a Good Hypothesis?

- Is the hypothesis based on information contained in the background research?
- Does the hypothesis include the independent and dependent variables?
- Have you worded the hypothesis so that it can be tested in the experiment?
- Is the time frame for testing this hypothesis sufficient?
- **With a good hypothesis, you should answer "Yes" to every question**

Experimental Design

- Plan carefully how to test your hypothesis, by altering the independent variable(s) and accurately measuring the dependent variable(s).
  - Don’t forget the control group.
- Develop clear written guidelines for laboratory procedures with enough detail to allow others to duplicate your work.

Experimental Design

- Develop a description and size of all experimental and control groups.
- List everything you must do to perform your experiment.
  - Think about all the steps that you will need to go through to complete your experiment, and how much time will be required for each step.
- Define how you will change your independent variable and how you will measure that change
- Define how you will measure the resulting change in the dependent variable(s)
- The experimental procedure should explain how the control variables will be maintained
- Specify how many times you intend to repeat your experiment, so that you can verify that your results are reproducible.
- Consider the analysis of data, graphical representation and appropriate statistical methods as appropriate.

- Remember: A good experimental design enables you or someone else to duplicate your experiment exactly!

Analysis & Reporting

- Ask for help.
- Consider statistical methods before you begin.
- Draw the data tables and set up worksheets so that data can easily added.
- Start drafting the final poster and manuscript early.
- Build the report as you go.

Developing the Student Proposal

Getting started.

- Ask your mentor for:
  - Review articles.
  - Grant proposals.
  - Presentations.

  - Develop a clear understanding of the “big picture”.

Components of the Proposal

- **Introduction**
- **Specific Aims**
- **Research Strategy**
  - ***Significance***
  - ***Innovation***
  - ***Approach*****,** including Preliminary Studies
- **References**

Proposal Development

- **Introduction**
  - State the importance of this area of research. Describe the problem or critical need being addressed.
- **Specific Aims**
  - State concisely the goals of the proposed research and summarize the expected outcome(s), including the impact on the research field(s) involved.
  - List succinctly the specific objectives of the research proposed, e.g., to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology.

Proposal Development

- **Research Strategy**
  - ***Significance***
  - Explain the importance of the problem or critical barrier to progress in the field that the proposed project addresses.
  - Explain how the proposed project will improve scientific knowledge, technical capability, and/or clinical practice in one or more broad fields.
  - ***Innovation***
  - Explain how the application challenges and seeks to shift current research or clinical practice paradigms.
  - Describe any novel theoretical concepts, approaches or methodologies, instrumentation or intervention(s) to be developed or used, and any advantage over existing methodologies, instrumentation or intervention(s).
  - ***Approach,*** including Preliminary Studies
  - Describe the overall strategy, methodology, and analyses to be used to accomplish the specific aims of the project.
  - Discuss potential problems, alternative strategies, and benchmarks for success anticipated to achieve the aims.
- **References**
  - *The references should be limited to relevant and current literature.*

Biosketch

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Charles R. Long	Assistant Professor
eRA COMMONS USER NAME (credential, e.g., agency login) crlong	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
University of Missouri, Columbia	B.S.	1986	Animal Science
University of Missouri, Columbia	M.S.	1989	Animal Science; Genetics
University of Massachusetts, Amherst	Ph.D.	1996	Veterinary & Animal Science

Biosketch

A. Personal Statement

B. Positions and Honor

Positions and Employment

Other Experience and Professional Memberships

Honors

C. Selected Peer-reviewed Publications

Most relevant to the current application

Additional recent publications of importance to the field (in chronological order)

D. Research Support

Ongoing Research Support

Completed Research Support

Ask for help as soon as you need it. Don’t delay.