What is Scientific Research?

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Different from …

- Market research
- Opinion research
- Research done mainly to find information – e.g., “research” car insurance policies
- Focus groups, product testing, prototype building, product demos, etc. – although they could all be PART of a research project.

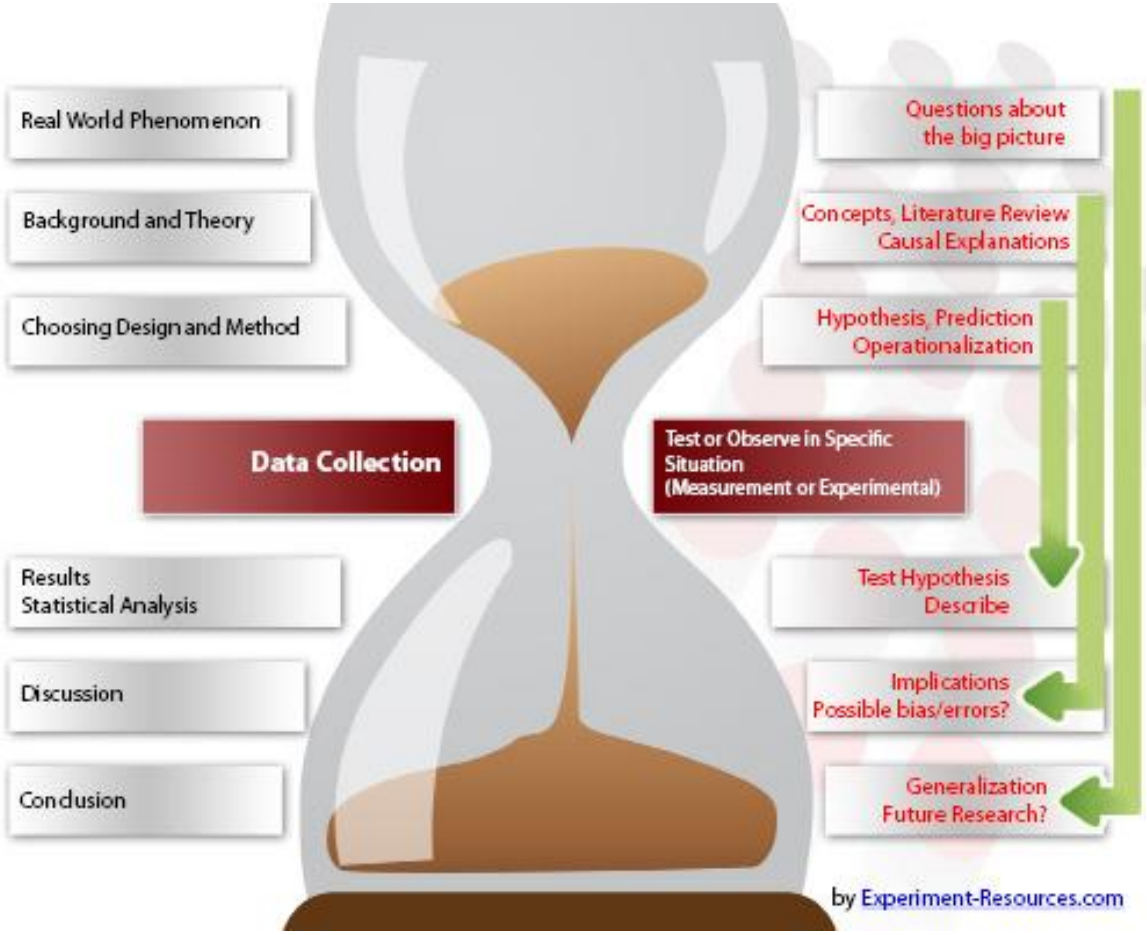
Definitions of Scientific Research

- In the broadest sense of the word, the definition of research includes any gathering of data, information and facts for the advancement of knowledge.
  – Shuttleworth, Martyn (2008). "Definition of Research". *Experiment Resources*. www.Experiment-Research.com. Retrieved November 28, 2011.

- Research is a process of steps used to collect and analyze information to increase our understanding of a topic or issue. It consists of three steps: Pose a question, collect data to answer the question, and present an answer to the question.
  – Creswell, J. W. (2008). *Educational Research: Planning, conducting, and evaluating quantitative and qualitative research* (3rd ed.). Pearson, Upper Saddle River, NJ.

- **Research:** a studious inquiry or examination; especially : investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws.
  – *Merriam Webster (m-w.com)*. Encyclopedia Britannica. Retrieved November 28, 2011.

Scope of Scientific Research

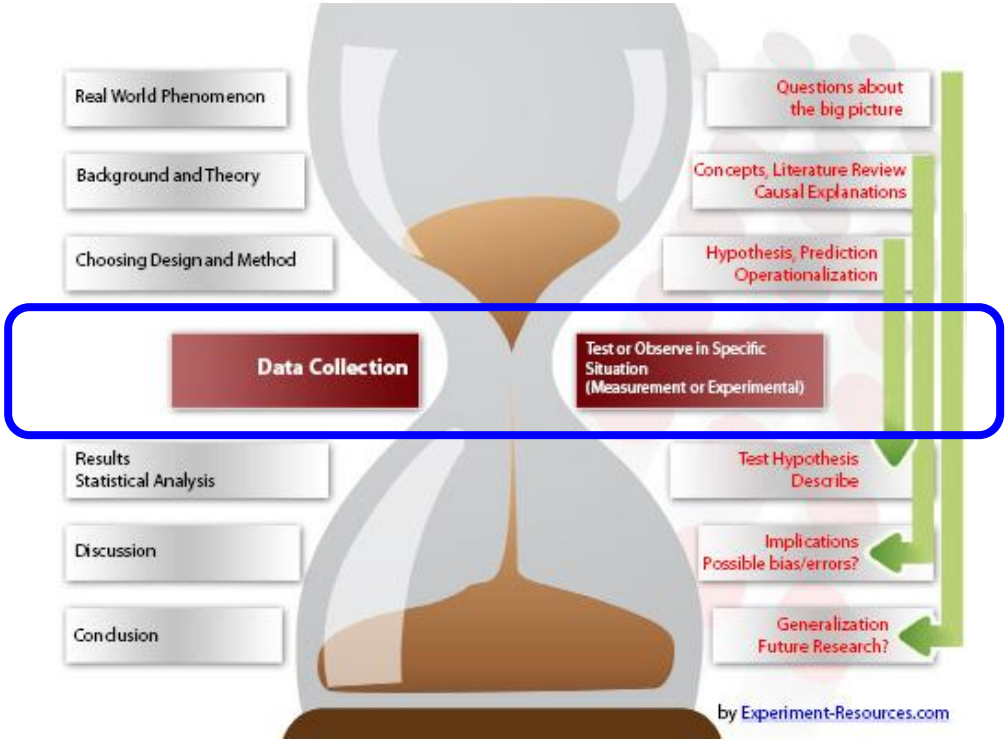


http://www.experiment-resources.com, retrieved on November 29, 2011

- "Big picture" is only addressable in small, well-defined, highly reproducible, bites.
- Observations of real world phenomenon + theories and background information from scientific literature lead to hypotheses.
- A well-posed hypothesis provides the framework for a well-designed experiment to test it.
- Hypotheses testing is the core of the scientific method.

Scope: Continued

- Reproducibility is critical in scientific research.
- Experiments must be designed to maximize reproducibility.
- This means the scope of what is being tested must be narrowed considerably from real-world situations.
- A good hypothesis will relate one or two (no more) independent variables to a single dependent variable.
- It should be possible to control the independent variables in the lab.
- It should be possible to accurately and reliably measure the dependent variable.



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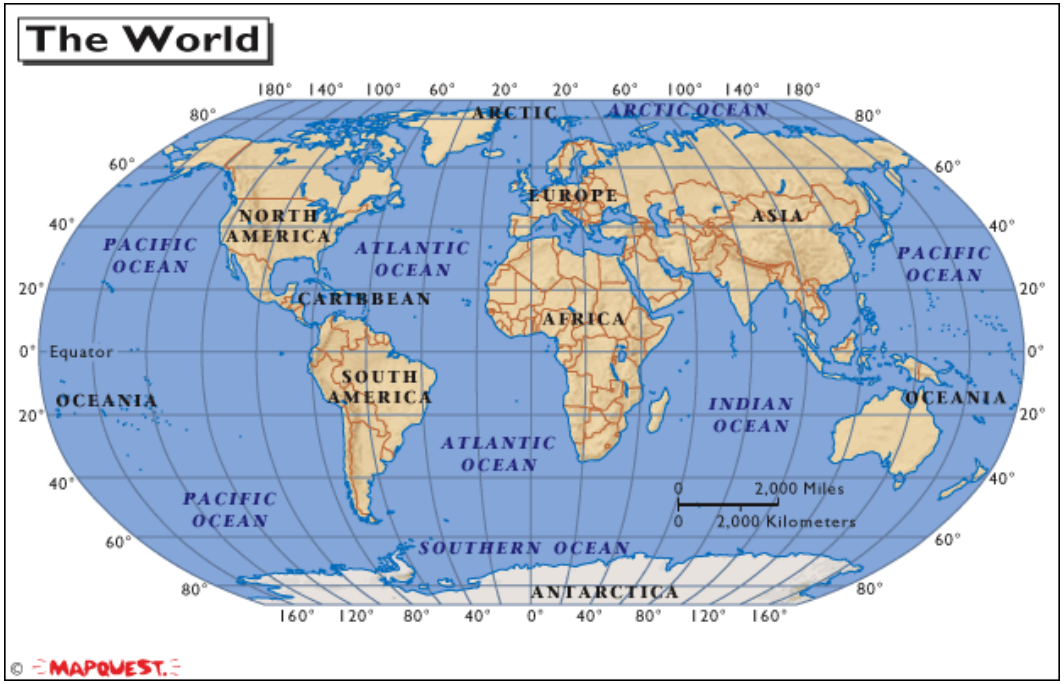
Example: Continental Drift

- **Observation:** Continents appear to fit together like pieces of a puzzle.

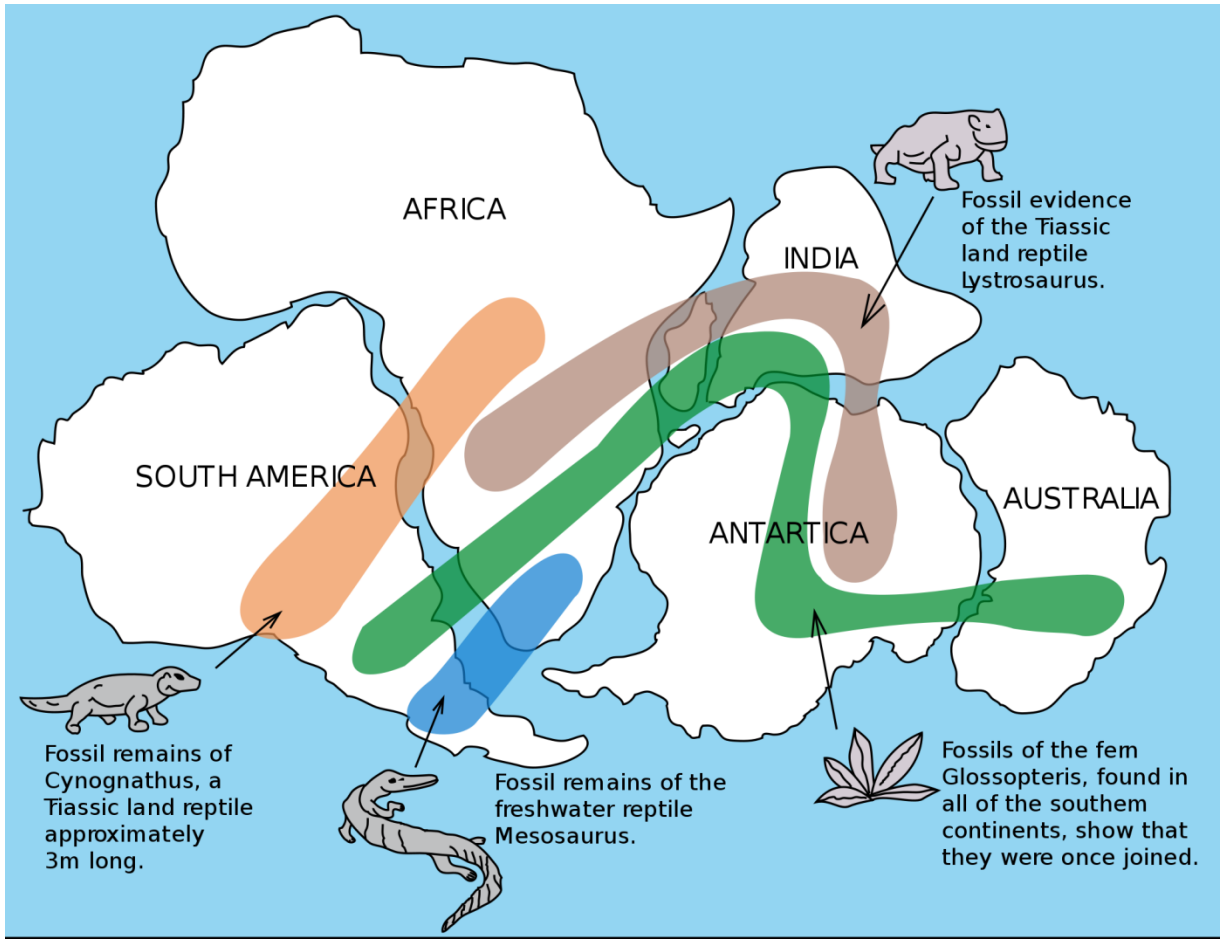
- **Deduction:** Hundreds of millions of years ago, all (or most) landmasses were connected, and drifted apart over time.



The hypothesis that continents 'drift' was first put forward by Abraham Ortelius in 1596 and was fully developed by Alfred Wegener in 1912.

Testable Hypothesis

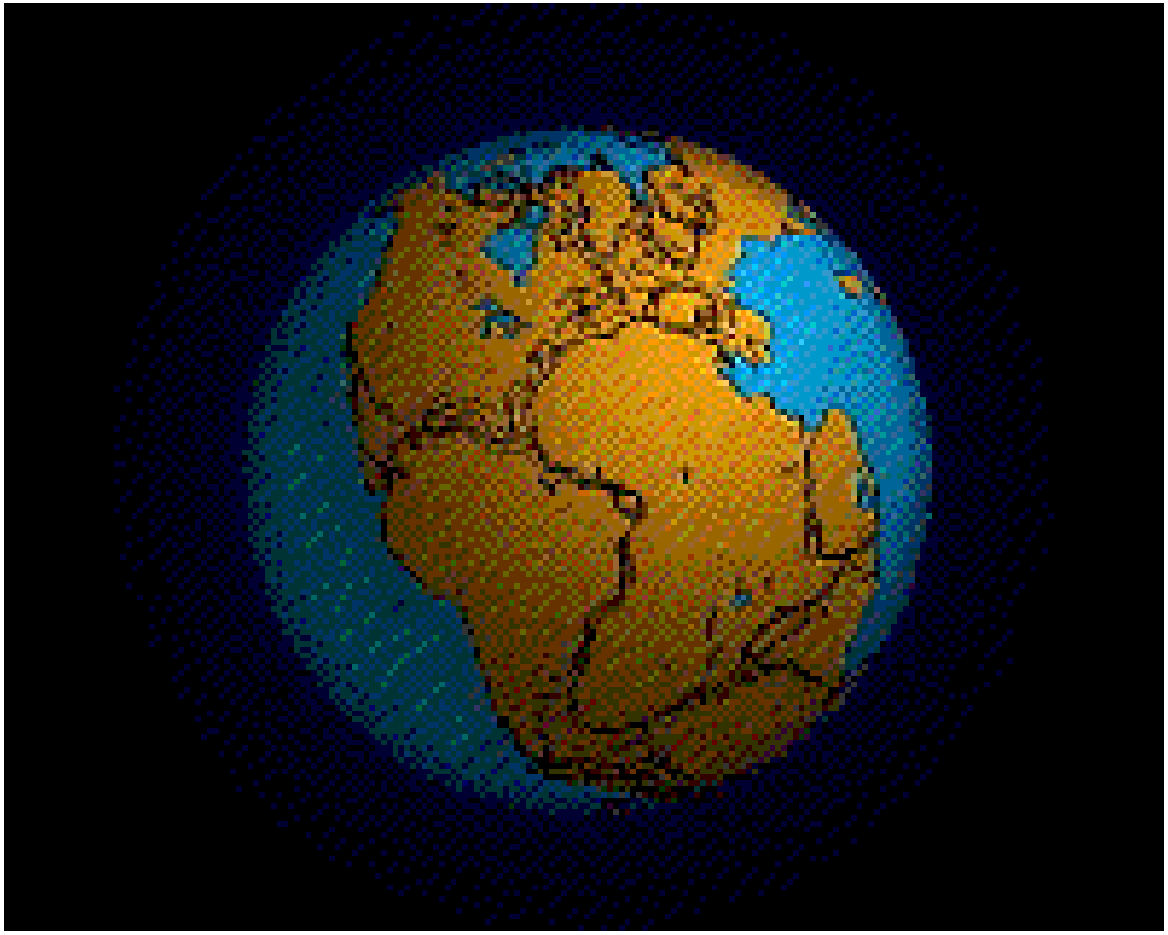
If continents drifted apart after life emerged on the planet, the fossil distributions on multiple continents from the same time period should show similarities.



- **Dependent variable:** Fossil distributions.
- **Independent variable:** Geological time

http://en.wikipedia.org/wiki/File:Snider-Pellegrini_Wegener_fossil_map.svg, retrieved on December 1, 2011

Further development: Plate Tectonics



http://en.wikipedia.org/wiki/File:Pangea_animation_03.gif, retrieved on December 1, 2011

Applied research

- Applied research is designed to solve *practical problems* of the modern world, rather than to acquire knowledge for knowledge's sake. One might say that the goal of the applied scientist is to *improve the human condition* .

- For example, applied researchers may investigate ways to:
  - improve agricultural crop production
  - treat or cure a specific disease
  - improve the energy efficiency of homes, offices, or modes of transportation

http://www.lbl.gov/Education/ELSI/research-main.html retrieved December 1, 2011

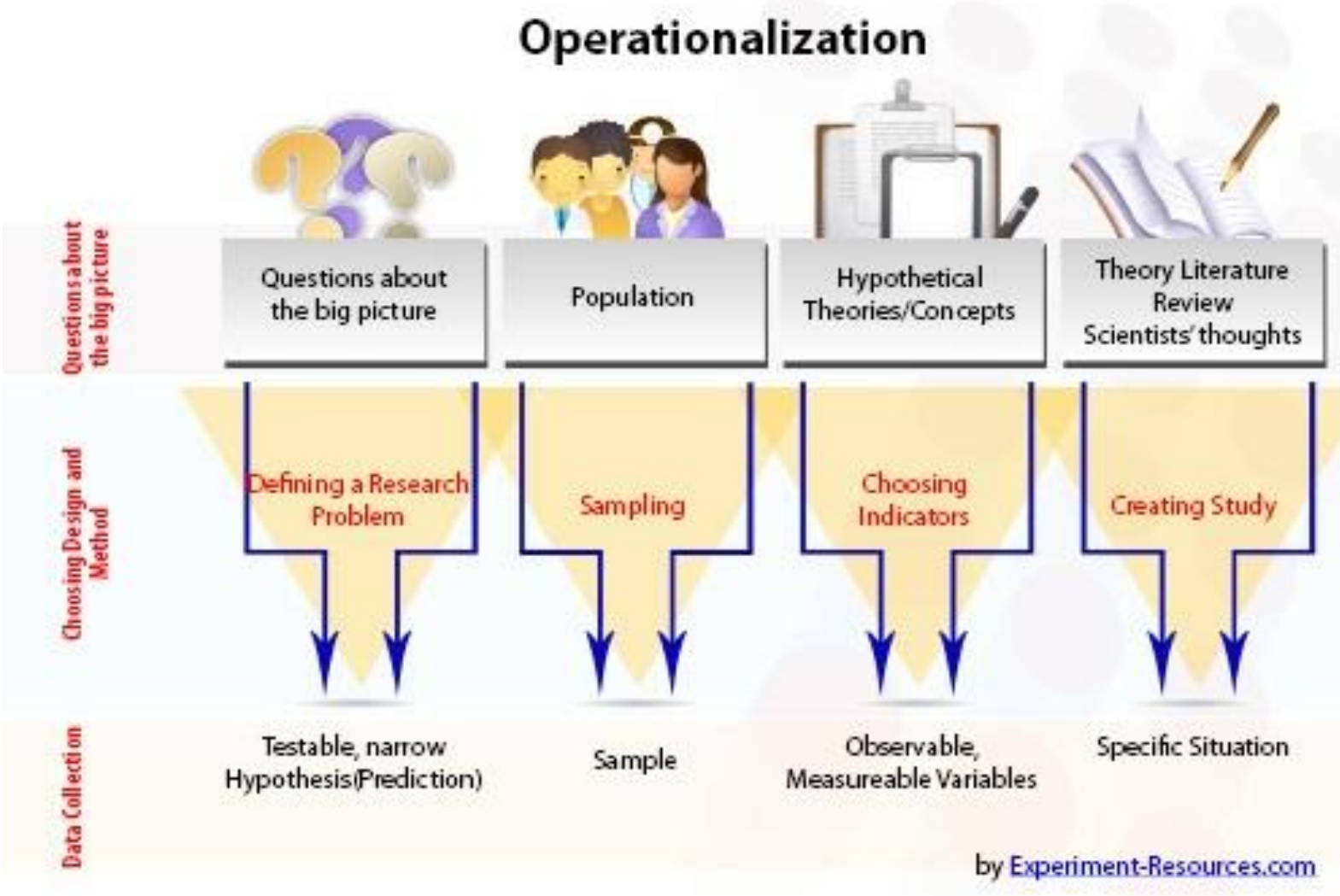
Applied research – another view

- accesses and uses some part of the research communities' (the academy's) accumulated theories, knowledge, methods, and techniques, for a specific, often state, business, or client driven purpose.

http://en.wikipedia.org/wiki/Applied_research, retrieved December 1, 2011

Conducting research

Research steps depend on the questions asked



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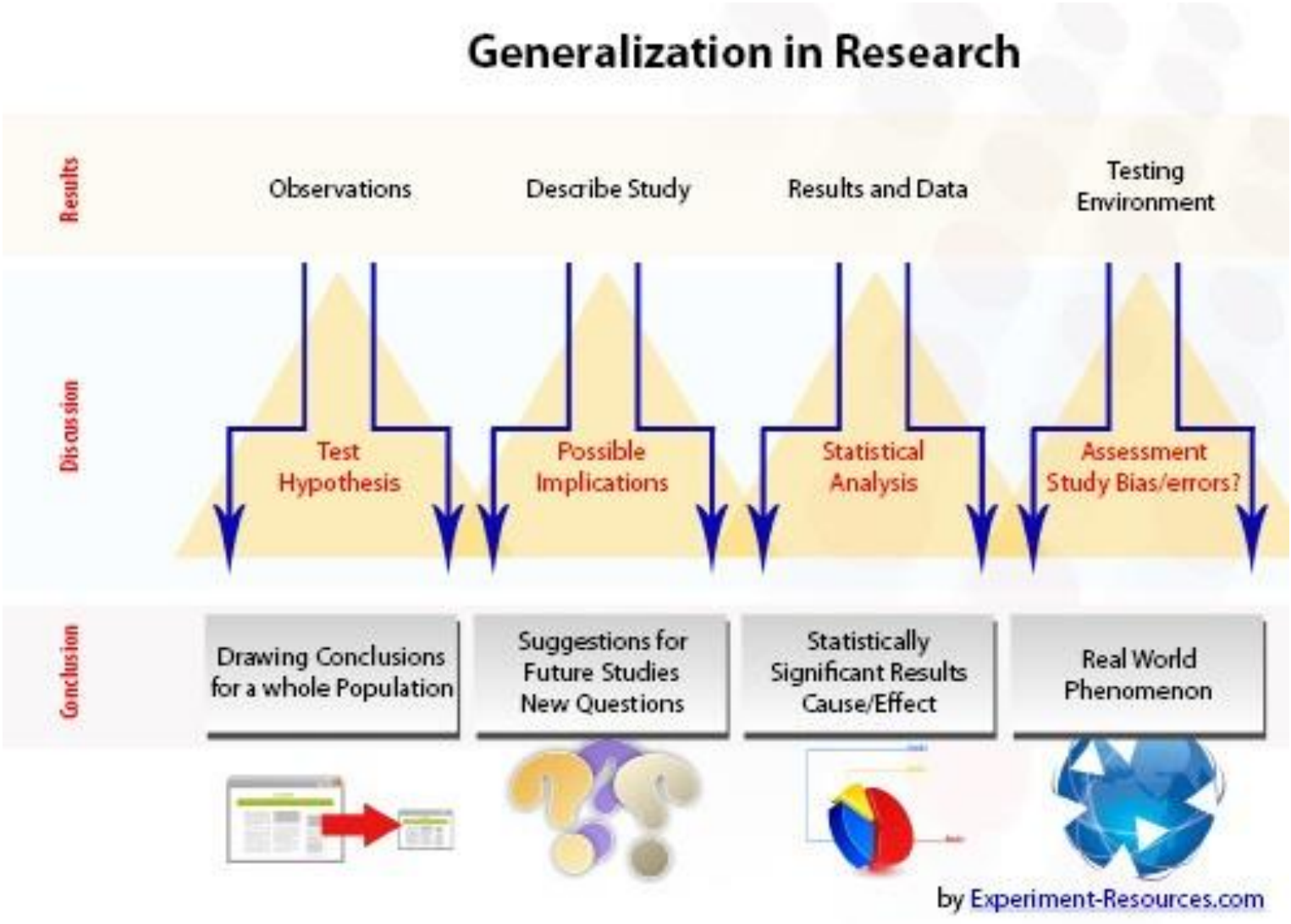
Publishing/presenting research



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Goals of this course

- Introduce you peer-reviewed to scientific literature; methods and strategies for effectively using scientific literature.
- Formulation of hypotheses and identification of methods to test them.
- Ethical considerations in research.
- Statistics in research, and design of experiments.
- Conventions and considerations to be used in scientific writing.
- Formatting documents to a given set of standards.
- Recognizing and handling experimental errors.
- Structure of a research proposal.
- Presentations and posters for disseminating research

Q & A