



RESEARCH METHODOLOGY

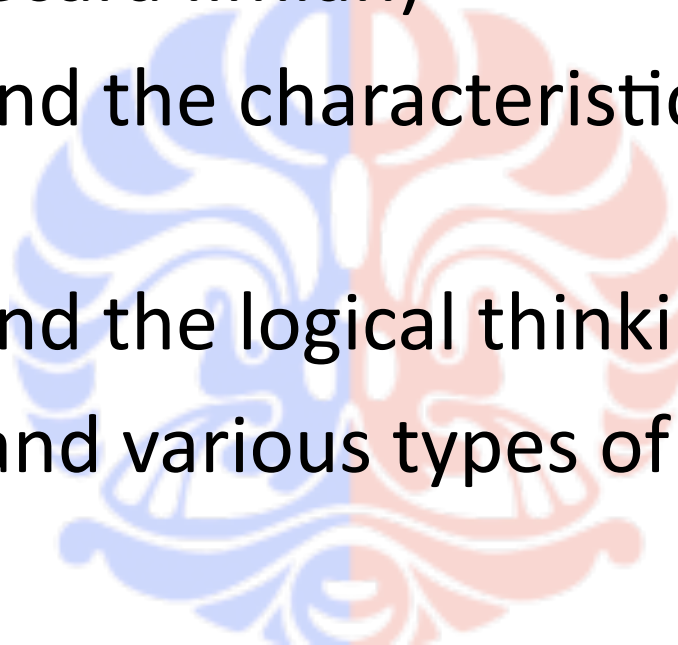
CM #2: Model of Scientific Inquiry

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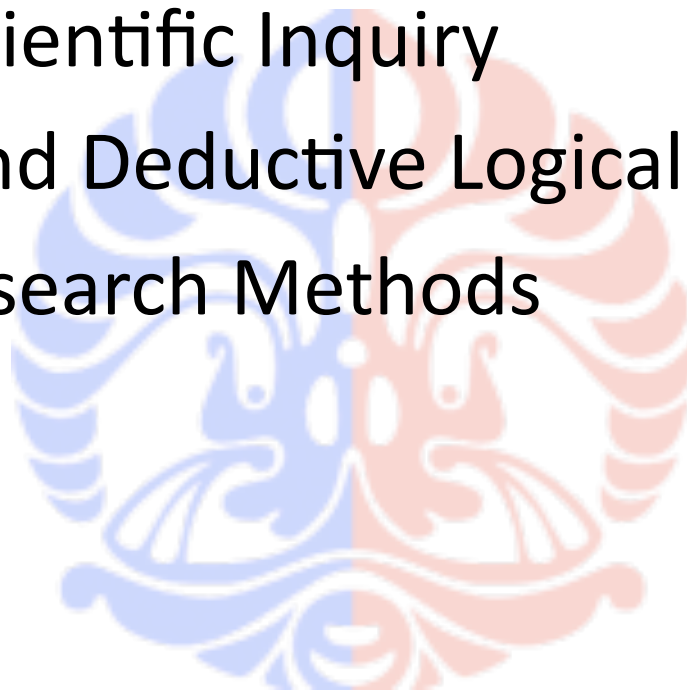
Session Objectives

- To understand the steps in Scientific Inquiry (Bertanya secara Ilmiah)
- To understand the characteristics of Scientific Methods
- To understand the logical thinking in Research
- To understand various types of Research



Session Agenda

- What is Scientific Inquiry?
- Model of Scientific Inquiry
- Inductive and Deductive Logical Thinking
- Types of Research Methods

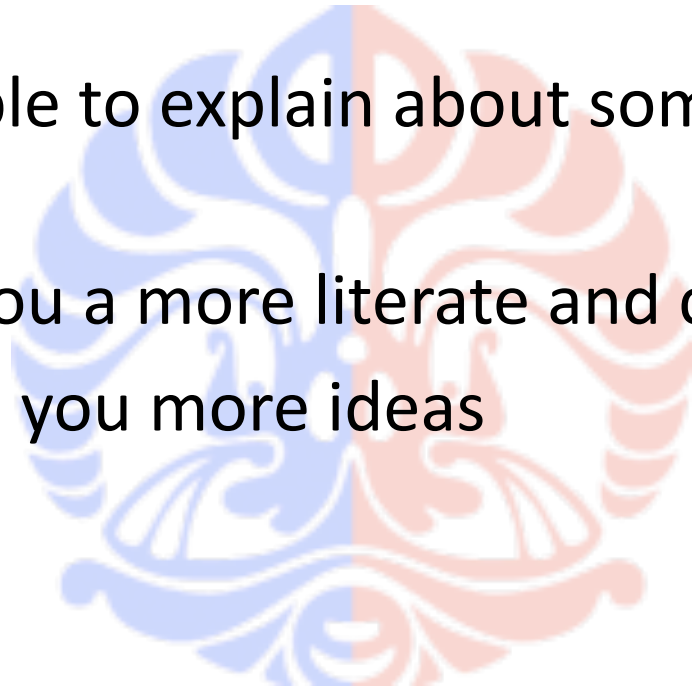


What is Scientific Inquiry?

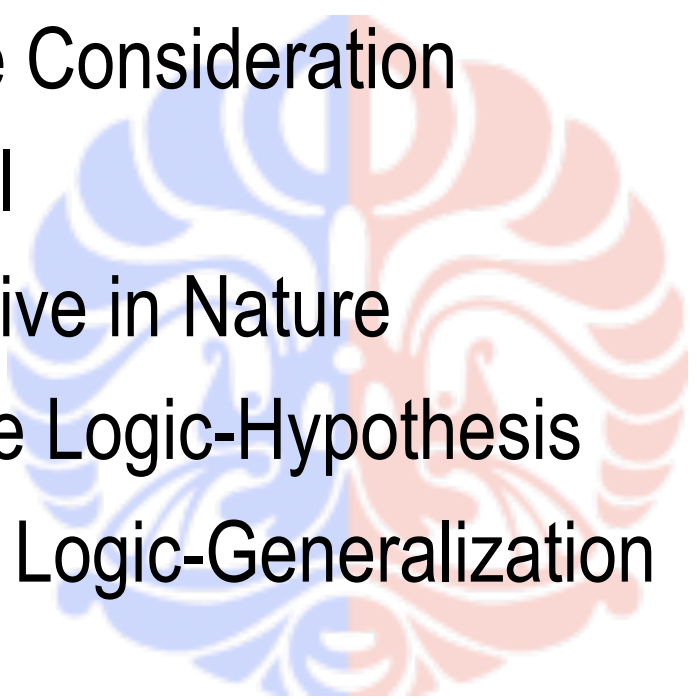
- Scientific inquiry is a term that encompasses a variety of techniques that scientists use to explore the natural world and propose explanations based on the evidence they find.
- The objective of scientific inquiry is to find and to characterize the patterns as resulted from the exploration.
- Scientific inquiry is founded on experiment and observations as opposed to purely rational or isolated logical thought.
- Scientific Inquiry can enrich our understanding of science

Why Scientific Inquiry ?

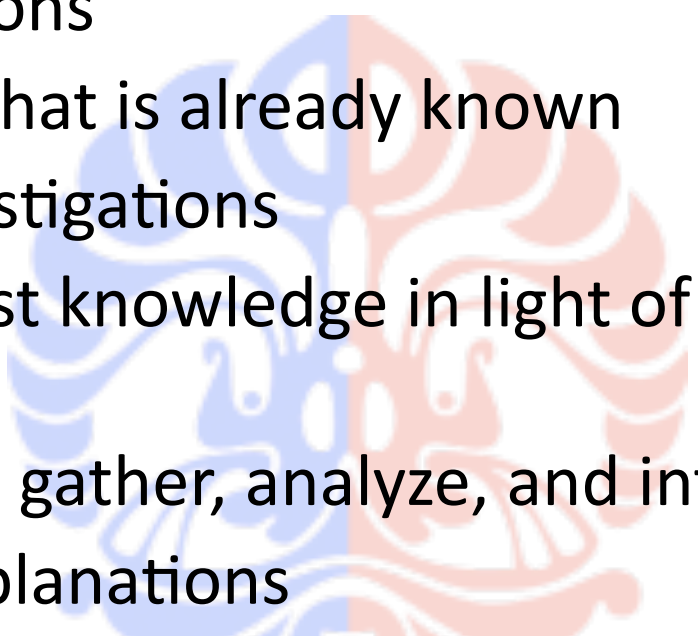
- It will make you more knowledgeable about something.
- You will be able to explain about something more thorough
- It will make you a more literate and cultured person.
- It will provide you more ideas



Characteristics of Scientific Inquiry

- Based on facts
 - Objective Consideration
 - Analytical
 - Quantitative in Nature
 - Deductive Logic-Hypothesis
 - Inductive Logic-Generalization
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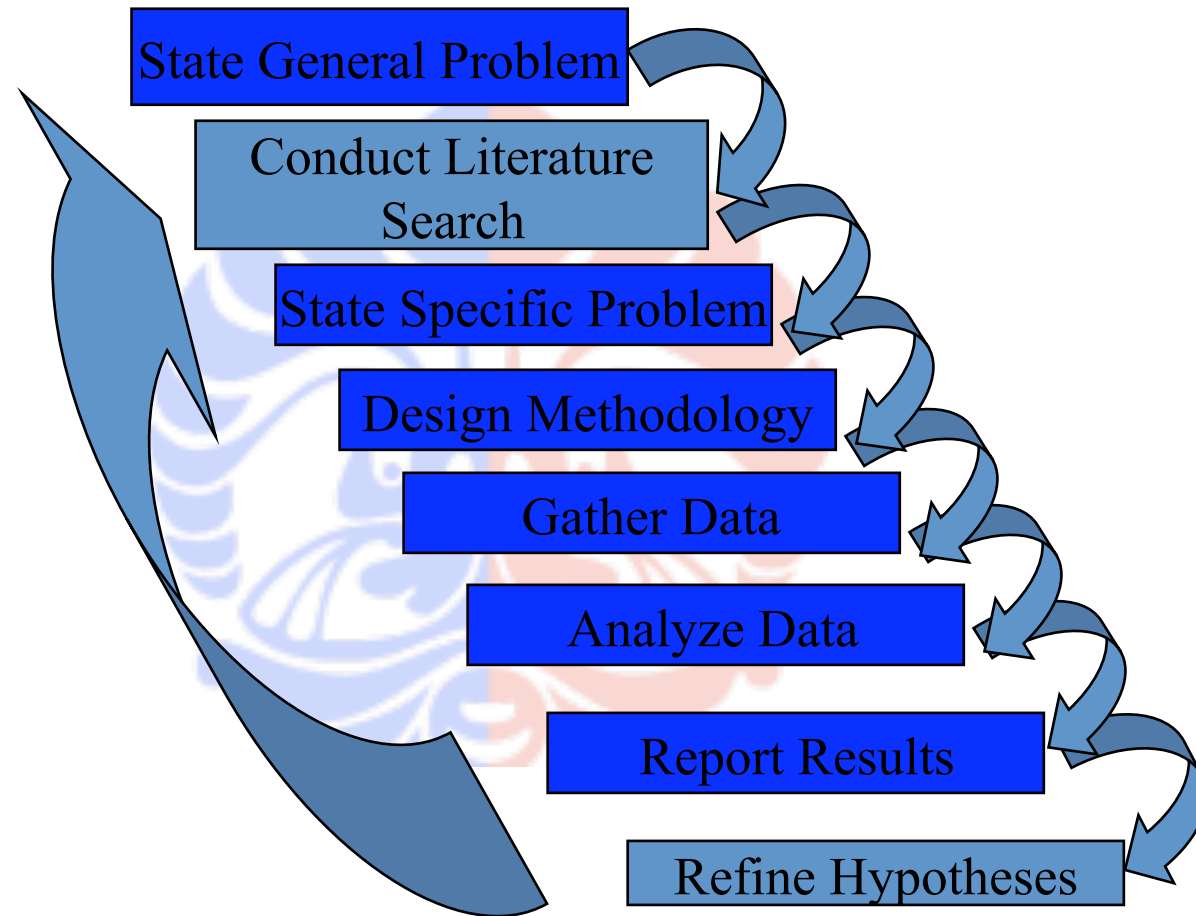
Activities in Scientific Inquiry

- Making observations
 - Posing questions
 - Finding out what is already known
 - Planning investigations
 - Reviewing past knowledge in light of experimental evidence
 - Using tools to gather, analyze, and interpret data
 - Proposing explanations
 - Communicating the results.
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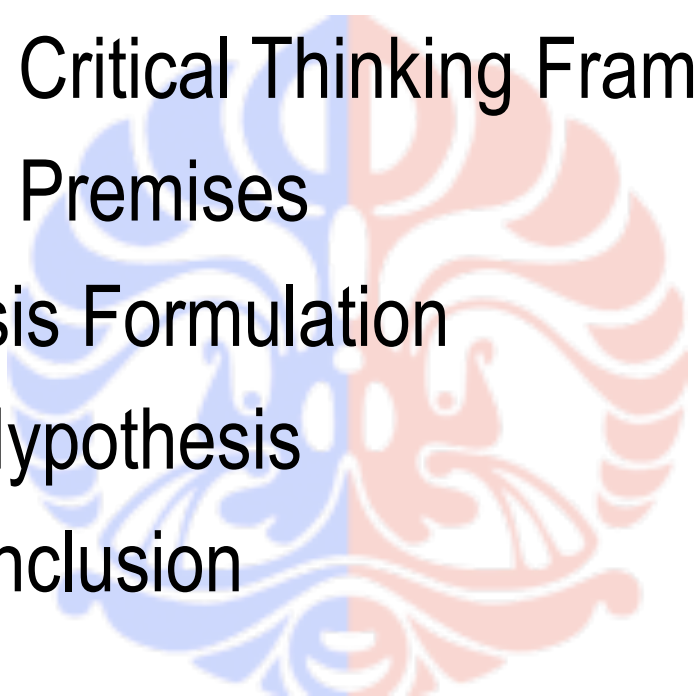
Models of Scientific Inquiry

- **Classical model**
 - The classical model of scientific inquiry derives from Aristotle, who distinguished the forms of approximate and exact reasoning, set out the threefold scheme of abductive, deductive, and inductive inference, and also treated the compound forms such as reasoning by analogy.
- **Pragmatic model**
 - Chales Peirce considered scientific inquiry to be a species of the genus *inquiry*, which he defined as any means of fixing belief, that is, any means of arriving at a settled opinion on a matter in question.
 - He observed that inquiry in general begins with a state of uncertainty and moves toward a state of certainty, sufficient at least to terminate the inquiry for the time being.

General Model of Scientific Inquiry



Another Model.....

- Problem Statement
 - Organize Critical Thinking Framework
 - Organize Premises
 - Hypothesis Formulation
 - Testing Hypothesis
 - Draw Conclusion
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Output of Each Step

- State General Problem
 - Statement that stated general problems
 - Example: Will the universe expand forever?
 - Exercise: State at least three general problems on your own.
- Conduct Literature Search
 - List all related literatures to the problems stated
 - Underline all theories, techniques, methods, findings and so forth that others have found
 - Critically analyze all the weaknesses, strengths, similarities, dissimilarities among those theories, techniques, findings above.
 - Summarize all those literatures (make annotated bibliographies)

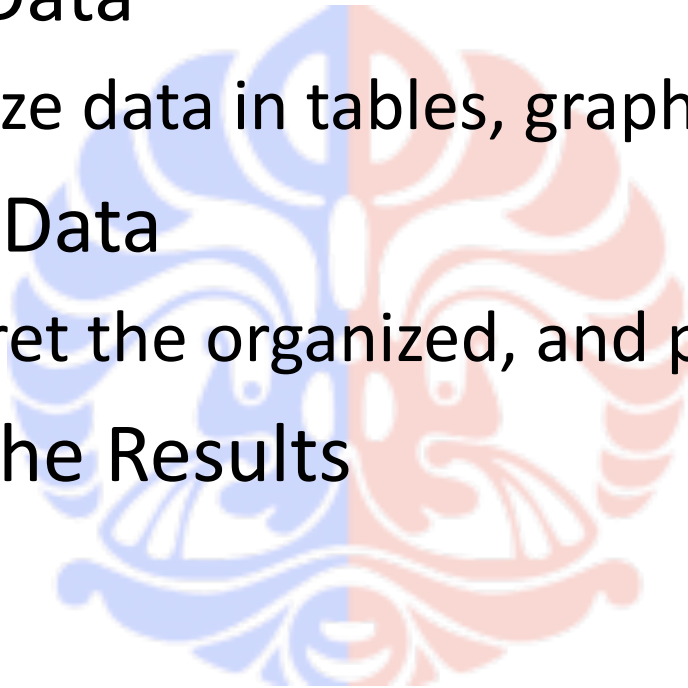
Output of Each Step



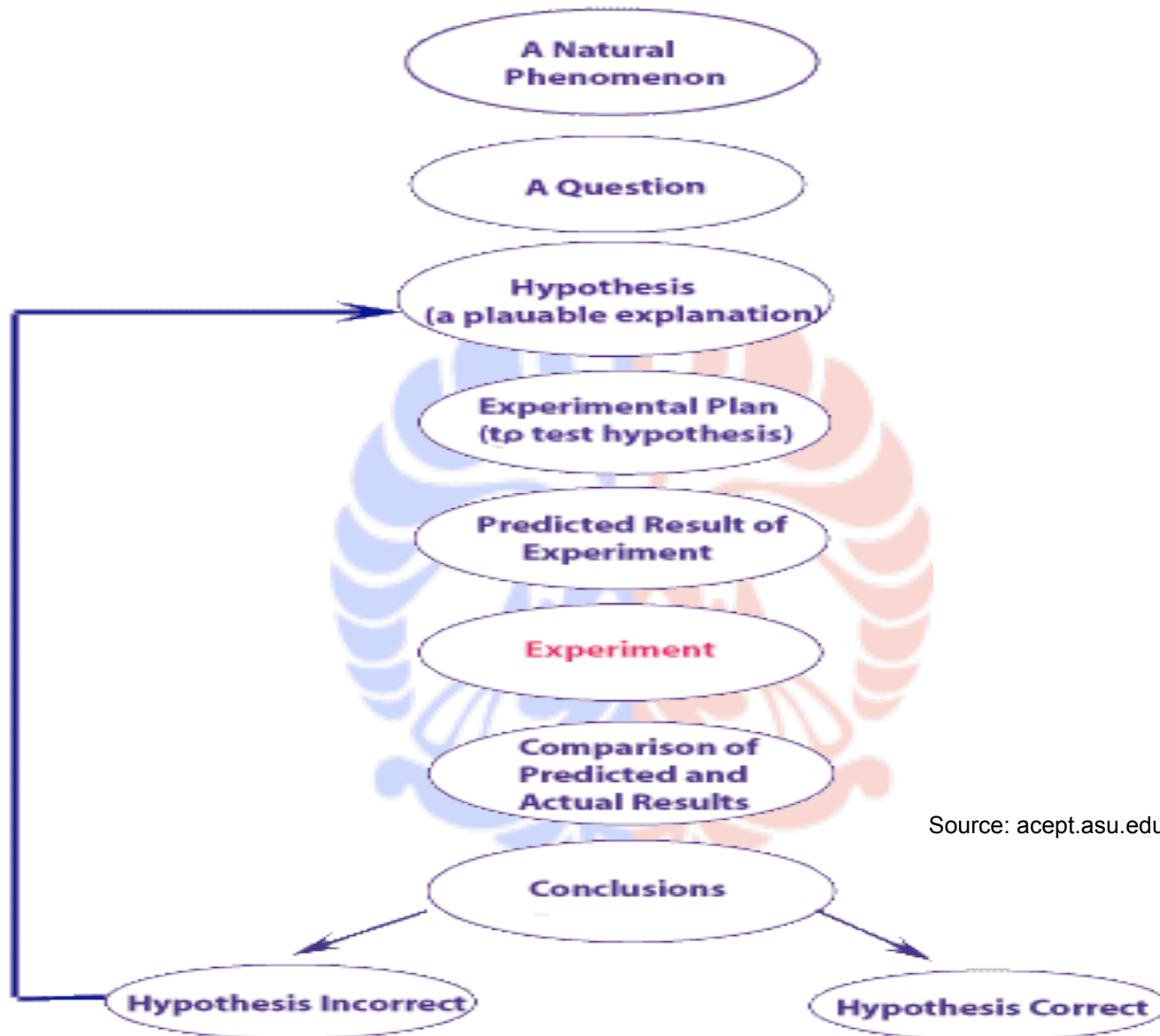
- **State Specific Problem**
 - Statement of general problem to specific problem
 - Example: What are the factors that cause the universe expanded?
 - Exercise: State at least two specific problems that derived from the above exercise
- **Design Methodology**
 - List all steps to be taken in order to answer those stated problems
 - Establish the setting of experiment
 - Provide all necessary means, tools, instruments
 - Define the object, variables, etc

Output of Each Step

- Gather Data
 - Organize data in tables, graphics
- Analyze Data
 - Interpret the organized, and processed data
- Report the Results



Simplist Form of Scientific Inquiry

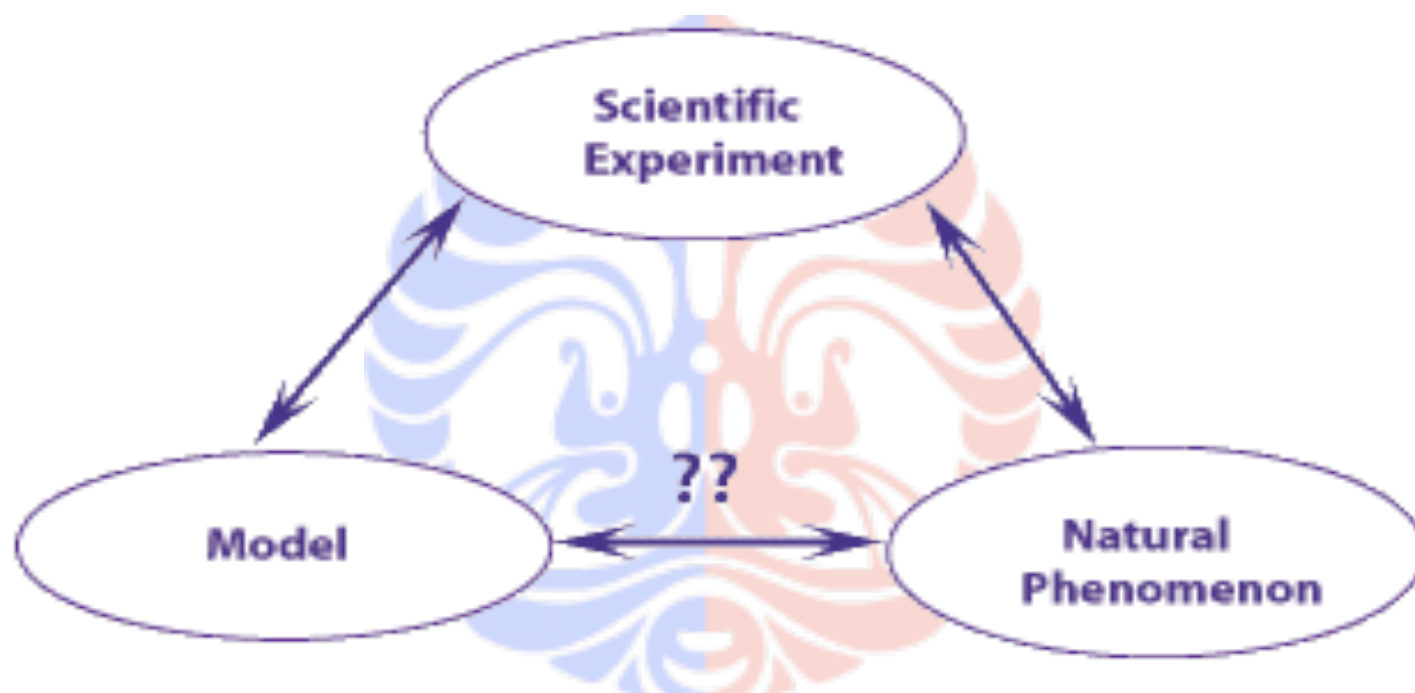


Source: accept.asu.edu/courses/phs110/chapter1

Model Development in the Physical Science



Key Components of Scientific Inquiry



Example of Model Development: What Factors Determine the Visibility of a Rainbow?

Working Model

Sunlight travels straight through rain drops where it is dispersed into colors, and then the light travels straight into my eyes



Proposed Experiment

While it is raining early one morning, I will face toward the rising Sun in the east to view a rainbow.



Predicted Results

I will see a rainbow in the sky as I look east on a rainy morning.



Actual Result

No rainbow was observed toward the east. However, I did see a rainbow when I turned around and looked west

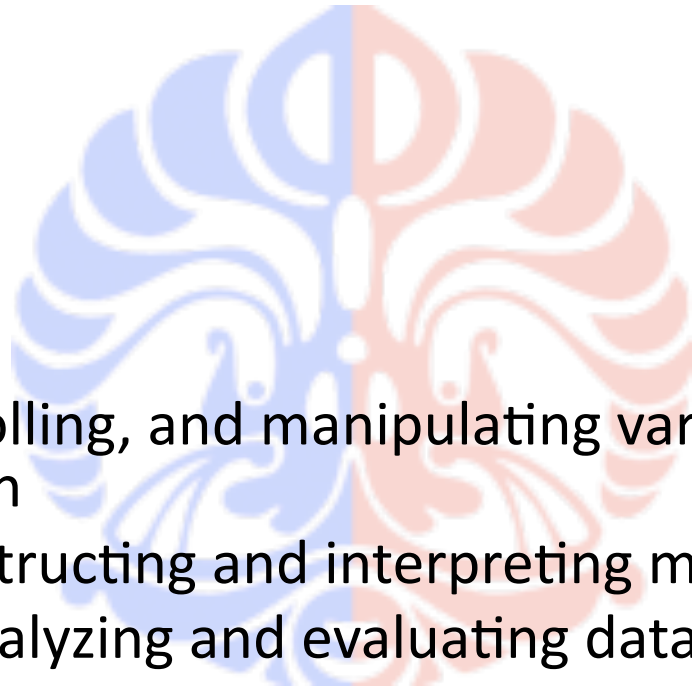


Conclusion

My working model requires revision. The Sun must be behind me to view a rainbow. There must be another effect in addition to light being dispersed into color in the rain drop. How can the light get re-directed into my eyes?

Basic Skills of Scientific Inquiry

- Observing
- Classifying and sequencing
- Communicating
- Measuring
- Predicting
- Hypothesizing
- Inferring
- Defining, controlling, and manipulating variable in experimentation
- Designing, constructing and interpreting models
- Interpreting, analyzing and evaluating data



Uses of Scientific Inquiry

- Make connections with world situations
- To encourage more active problem solving approach to learning and thinking
- To apply math skills
- Review what is already known in light of experimental evidence
- Propose answers, explanations and predictions
- Use tools to gather, analyze and interpret data

Exercises Your Thought

- Develop a scientific model of your own
 - Post deliverables of each step of the model
- Categorized the scientific model into a research method
- Give examples of deductive and inductive logics

