

Appendix 1: Lesson Plans

“It’s All in the Bag: The Scientific Method in the Active Learning Classroom”

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Goal

To introduce students in introductory courses to basic concepts and issues related to the application of the scientific method in the social sciences.

Objectives

The student will:

1. accurately define the terms *hypothesis*, *falsifiability*, *replicability*, *parsimony*.
2. list at least two problems associated with the study of unobservable phenomena and the application of the scientific method in the social sciences.
3. explain the main elements of scientific method in terms of the theory development - hypothesis generation – hypothesis testing cycle.
4. list characteristics of good social science and of good social science theories.
5. progress in developing critical thinking and inference skills.
6. distinguish between positive and normative political science

Materials

Student reproducible handout – one per group. (See Appendix 2.)

Fabric or opaque plastic drawstring-type bags – one per group.

Small, difficult to identify objects, as might be found in a ‘Dollar Store’ – one per group. See suggestions and descriptions in main essay, available on personal home page listed above.

(NOTE: Objects should be concealed in bags prior to student contact.)

Duration

Allow approximately 35-40 minutes for 5 groups. For more groups/objects or for longer discussions, allow more time.

Procedure

I. Introduction: Inductive Exploration

1. Divide students into groups of (ideally) 4-6. Have each group designate a Recorder.
2. Invite each Recorder to select a bagged object from you; instruct Recorders and groups to keep bags *closed*. Distribute one copy of “Recorder Questions” (reproducible in Appendix) to each Recorder.
3. Inform remaining group members that their task is to identify the object in their bag using any methods of their choice *other than opening the bag*. Encourage students to answer questions such as, ‘What is it called? How big is it? What color is it? With what material(s) is it made? What is its use or function?’ Any and all pertinent details that the group can discern should be noted as the group members think aloud to complete the process. The Recorder’s task is to observe and record the process by which the group completes its task; the Recorder does *not* participate in discovery.
4. Allow 5-10 minutes for the groups to explore and identify their objects. Circulate and observe; ask questions to press students to offer more complete or more detailed

descriptions of their objects. Some groups will complete their task more quickly than others; you might encourage these groups to trade objects, name a new Recorder, and repeat the process. (Additional copies of the Recorder sheet are useful for this.)

II. Experience Pooling and Concept Discovery

1. Reclaim class attention as most groups conclude their investigations. Ask each Recorder to describe the group's reasoning process. You might ask some groups specifically to discuss alternative hypotheses proposed by group members as well as the group's final conclusions, or you might instead ask about how the group used observable implications to exclude or discredit potential alternative hypotheses. ('What else did your group suggest? What made them change their minds?')
2. After a Recorder describes the group's findings, remove the group's object from its bag and reveal it to the class. Discuss any points on which the group's conclusions were particularly accurate, particularly inaccurate, or (as is most often the case) notably incomplete.
3. If multiple groups examined a given object, you might ask all involved Recorders to discuss their findings before revealing the object.
4. Discussion points:
 - a. Step 1: For most objects, this phase can generate good discussions of the *theory generation – hypothesis generation – hypothesis testing cycle*. Groups often identify one or two salient features of the object immediately and leap to a conclusion about the object, only to revise their conclusion as more information is gathered by the group members and collective discussion. (You could also discuss science as a social function of a community here, if the opportunity arises.) The discussion of the relationship between hypothesis testing and new theory generation is a good way to introduce *falsifiability* as a characteristic of good theory. Instructors may also choose to introduce the distinction between *positive* and *normative political science*: 'What *is* this object' or 'what *is* its function,' rather than 'what *should* this be' or 'what *should* it be used for.'
 - b. Step 2: This step usually allows for a good discussion about the problems inherent in studying unobservables. Most concepts of political science – anarchy, public opinion, power, globalization, culture – cannot be observed directly; we can only study the observable implications (often indirectly, at that) and must infer back to the underlying cause. Often, our inferences in the early stages of a research program are quite off the mark or startlingly incomplete as we grope to assemble the bits of information provided by different scholars into a single coherent picture of the phenomenon. Individual portions of the description may well be accurate, but the sum of the pieces is notably less than the parts or the revealed whole. (The parable of the three blind men who examine an elephant and describe their own findings as representing the entire animal is quite appropriate.)
Other notable problems include a reduced ability to falsify claims; when the existence or nature of the phenomenon itself is a contested concept, hypotheses about effects may become confounded with hypotheses about causes. This appears as students arguing over what that lump could be: is it the ear of an animal, something decorative, or something that should be ignored in favor of another feature of the object?

- c. Step 3: This provides an excellent opportunity to discuss *replicability* and *parsimony*. How much information did each group need to identify the object? Were there some features of the object that allowed one group to identify the object as soon as the features were identified? The groups examined the same ‘data’: Did they agree on all facets of the object’s description?

III. Extension and Evaluation

1. You might ask the class to brainstorm unobservable concepts in political science, and then have students suggest some observable implications as homework or brief in-class writing assignment. What would we see if this concept were, indeed, present in a situation or causing something? Exceptional students might go as far as to suggest how to falsify their own hypotheses: what would we see if this concept was present but another concept was causal?
2. For additional extensions throughout the course, you might ask students to brainstorm reasons why certain events or outcomes occurred, then follow with a question about observable implications of some of the suggested theories. Encourage students to think about falsifying these hypotheses.
3. Evaluation might include an essay question asking students to suggest ways to discriminate between rival hypotheses, or a brief response question asking the student to describe how data is used to refine theories.

Presenter Notes

Introduction: Groups smaller than 4 tend to have an insufficient number of discussants once a Recorder is named; groups larger than 6 often experience difficulty allowing all members to participate (or in some cases to examine the object) in the allotted time. Experience suggests that when the Recorder participates in discovery, only the group’s conclusions are noted rather than the reasoning process behind those conclusions.

Pooling and Discovery: The sequence in which objects are revealed and discussed should be arranged carefully and with a view toward the specific responses and concepts the instructor wishes to elicit from each group/object. Because objects will vary by instructor, no more precise guidance can be provided. I normally sequence object revelation to include observable implications and the theory development-hypothesis generation/testing cycle first, then advance to more complex concepts such as authority, contestability, and sunk costs (cell phone holder); falsifiability (film canister containing cotton balls); and the role of prior assumptions (ribbon scrap). Potential objects and suggested related concepts are included in the main essay, available from <http://www-personal.umich.edu/~lpowner> . Other concepts can be incorporated into the discussion at the instructor’s discretion based on the collection of objects available or other course conceptual needs.

All user feedback is welcome; please send to LPowner@umich.edu.

Questions for Group Recorder

Group Members:

To the Recorder: Please take as many notes as possible as your group members investigate the object in the bag. Note any and all suggestions made by group members, even ones the group ultimately rejects. Pay attention to the process by which your group reaches its conclusions as well as to the conclusions themselves.

1. What hypotheses did your group suggest? How were competing hypotheses compared and rejected? Did your group develop intermediate hypotheses that were generally accepted as fact ('it's round,' 'it's squishy,' etc.)?

2. What assumptions did your group make? How were they made—through a verbal process based on evidence or something more spontaneous? Did the group even notice the assumptions?

3. As an outside observer, did you agree with the assumptions that the group made? Did they seem reasonable given the evidence? Could you think of counter hypotheses? Were your ideas more or less accurate than the group's after the identity of the item was revealed?