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CHAPTER 2

The Nature of Science

Multiple Choice

1. According to the text, when students think of "scientists," they rarely think of

   a. chemistry and physics.
   b. white lab coats and test tubes.
   c. research activities.
   d. the formulation of theory.*

2. According to the authors of your textbook, the natural sciences and social sciences

   a. have nothing in common.
   b. share common philosophical and logical foundations.*
   c. differ primarily in how each defines the concept of "objectivity."
   d. differ insofar as the natural sciences are based on empiricism, whereas the social sciences are not.

3. The authors of the textbook take the position that

   a. social research is fundamentally scientific.*
   b. the general scientific method may be applied to some social science topics but not to others.
   c. the social sciences should model themselves after the natural sciences in terms of the structure of scientific theory but not in terms of the scientific "process."
   d. the social sciences are less scientific than the natural sciences because they cannot be as objective.

4. The most essential, defining "product" of science is

   a. ideas in the form of principles and theories.*
   b. technological advances such as telecommunications, laser beams, and computer chips.
   c. precise measurement and accurate prediction.
   d. discoveries such as new planets, new organisms, and medical cures.

5. Which of the following is an example of a scientific question?

   a. To what crimes should capital punishment apply?
   b. Should clinical abortions be government funded?
   c. Should intelligence tests be used in the schools?
   d. Is political corruption a serious problem in the United States?
   e. Why do women have abortions?*

6. Which of the following is *not* a rule about language usage in science?

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a. One word, one concept.
b. Concepts must be linked to observable objects and events.
c. Concepts should stand the test of time.*
d. Concepts should be judged by their usefulness.

7. Social scientists have found consistent, substantial empirical support for the following proposition: As the size of a group increases, its complexity increases. This conclusion best represents a

a. theory.
b. law.*
c. hypothesis.
d. concept.
e. paradigm.

8. Which of the following statements is *true* of scientific theory?

a. Scientific theories can be proven logically.
b. There can be one and only one true theory of any social phenomenon.
c. Theories are less abstract than hypotheses.
d. Theories can be expressed as a logically interconnected set of propositions.*

9. Freud's death wish is an example of

a. explanation without prediction.*
b. prediction without explanation.
c. neither explanation nor prediction.
d. an objectively testable proposition.

10. The ultimate goal of scientific inquiry is

a. the accumulation of facts.
b. the advancement of technology.
c. prediction and control.
d. hypothesis testing.
e. understanding.*

11. Scientific theories provide a sense of understanding by

a. introducing a unique set of concepts.
b. making accurate predictions.
c. describing the causal process that connects events.*
d. connecting one set of generalizations to another.

12. Which statement most accurately describes scientific knowledge or theory?

a. It is the best understanding that we have been able to produce thus far.*
b. When perfected, it is a statement of what is ultimately real.
c. A theory is accepted as "scientific" when objective tests confirm its predictions.

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d. Theory in a scientific discipline is essentially an inventory of the currently most accurate predictions.

13. The textbook describes science as both a product and a process. The "process" consists of

a. the development of scientific theory.
b. the continuous interaction of theory and data.*
c. logical reasoning.
d. the application of precise scientific instruments.

14. The most accurate depiction of the scientific process is that it

a. always begins with theory and ends with research.
b. involves a continuous interplay between theory and data.*
c. consists of the logical and empirical proof of hypotheses.
d. is an orderly procedure for making systematic observations.

15. In his study *Suicide*, Durkheim

a. developed a comprehensive theory of suicide that included climatic, psychological, and social causes.
b. attempted to explain individual differences in types of suicide.
c. examined variation in suicide rates among different nations and groups.*
d. did not produce a single finding that has stood the test of time.

16. Why is Durkheim's study *Suicide* a model of social scientific inquiry, even today?

a. It provided the first extensive quantitative analysis of suicide.
b. It presented the first truly scientific theory of suicide.
c. Virtually all of its predictions have been confirmed repeatedly by other investigators.
d. It showed how scientists use data to test theory and develop theories from data.*

17. To say that scientists follow principles of logical reasoning is to say that

a. logical proof is the primary means of verifying hypotheses.
b. logic provides the criteria for evaluating scientific reasoning.*
c. scientists use logical rules to infer theory from observations or data.
d. logic suggests how to test scientific theory.

18. What is the objective of logic or logical analysis?

a. to describe human thought processes
b. to facilitate creativity and imagination
c. to empirically validate scientific theory
d. to evaluate reasoning*

19. What is the primary difference between deductive and inductive logic?

a. the quality of the evidence supporting a conclusion
b. the certainty that a conclusion is true, based on the evidence*

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c. whether a conclusion can be drawn, based on the evidence
d. the closeness of the association between evidence and conclusion

20. In valid *deductive* reasoning, if the evidence is true, the conclusion

a. may be true or false.
b. may be strong or weak.
c. must be true.*
d. depends on the variety of supporting evidence.

21. Someone studying homelessness finds that the first four homeless people he examines are mentally ill. He therefore concludes that all homeless people are mentally ill. What type(s) of reasoning is this?

a. deductive reasoning
b. inductive reasoning*
c. neither deductive nor inductive reasoning
d. both deductive and inductive reasoning

22. Which of the following sequences best describes the *inductive* logic of inquiry?

a. theory → data → hypothesis
b. data → theory → hypothesis
c. data → empirical pattern → theory*
d. theory → hypothesis → data
e. empirical pattern → hypothesis → theory

23. Which of the following sequences best describes the *deductive* logic of inquiry?

a. theory → data → hypothesis
b. data → theory → hypothesis
c. data → empirical pattern → theory
d. theory → hypothesis → data*
e. empirical pattern → hypothesis → theory

24. Scientists engage in *deductive* reasoning when they

a. show how a hypothesis follows from a theory.*
b. infer empirical patterns from data.
c. formulate a theory to account for empirical patterns.
d. infer the validity of a theory from a set of data.

25. Based on the "mental alienation" theory of suicide, Durkheim argued that groups with higher rates of insanity will have higher rates of suicide. Women have higher rates of insanity than men. Therefore, women have higher rates of suicide than men. What type(s) of reasoning is this?

a. deductive reasoning*
b. inductive reasoning
c. neither deductive nor inductive reasoning

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d. both deductive and inductive reasoning

26. According to Durkheim's theory of suicide, the more socially integrated a group, the lower its suicide rate. Catholics are more socially integrated than Protestants. Therefore, the suicide rate is lower among Catholics than among Protestants. What type(s) of reasoning is this?

    a. deductive reasoning*
    b. inductive reasoning
    c. neither deductive nor inductive reasoning
    d. both deductive and inductive reasoning

27. Durkheim found that predominantly Catholic nations had lower suicide rates than predominantly Protestant nations, and that married people had lower suicide rates than single people. Noting that both Catholics and married people are more socially integrated than their counterparts, he theorized that the more socially integrated a group, the lower its suicide rate. What type(s) of reasoning is this?

    a. deductive reasoning
    b. inductive reasoning*
    c. neither deductive nor inductive reasoning
    d. both deductive and inductive reasoning

28. In a *deductive* argument the conclusion may be _____, whereas in an <u>inductive</u> argument the conclusion is _____.

    a. true or false; more or less probable*
    b. valid; invalid
    c. true or false; always true
    d. valid or invalid; true or false

29. In contrast to deductive reasoning, inductive reasoning

    a. is *not* based on empirical evidence.
    b. involves conclusions that are more or less probable.*
    c. is less descriptive of human thought processes.
    d. moves from general principles to particular conclusions.
    e. should be avoided in science whenever possible.

30. When Durkheim formulated his theory of egoistic suicide from several established facts he used _____ ; when he showed how his theory explained the facts he used _____.

    a. deductive reasoning; inductive reasoning.
    b. deductive reasoning; valid reasoning.
    c. valid reasoning; deductive reasoning
    d. inductive reasoning; deductive reasoning*
    e. valid reasoning; inductive reasoning

31. An observer of street corner groups finds that more acts of vandalism are committed by same-sex groups than by mixed-sex groups. She speculates that the propensity to commit

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publicly deviant acts is a product of competition for recognition among peers of equal status. This is an example of

a. prediction without explanation.
b. deductive reasoning.
c. inductive reasoning.*
d. hypothesis testing.

32. According to the deprivation theory of religiosity, people who are denied gratification within the secular society will be more likely to turn to the church as an alternative source of gratification. The United States is a male-dominated society in which women are denied the level of gratification enjoyed by men. Therefore, women will be more religious than men. This is an example of

a. logical inconsistency.
b. feminist reasoning.
c. deductive reasoning.*
d. inductive reasoning.

33. The three key principles underlying scientific research are

a. observation, theory, experiment.
b. prediction, experiment, serendipity.
c. empiricism, objectivity, control.*
d. deduction, induction, generalization.

34. The principles of empiricism, objectivity, and control

a. are found in the social sciences but not in the natural sciences.
b. guide the collection and evaluation of scientific evidence.*
c. are recent innovations in the scientific method.
d. complement intuition and revelation as ways of knowing in the social sciences.

35. According to the notion of empiricism, questions about the social world should be settled by resorting to

a. rational reflection.
b. logical reasoning.
c. careful, public discussion.
d. direct or indirect observation.*

36. Which phrase best captures the meaning of "objectivity" as it applies to scientific inquiry?

a. Observational evidence that is completely free of bias.
b. Evidence that is not subject to interpretation.
c. Agreement among independent observers of the same event.*
d. Agreement between scientists' observations and the external world.

37. The revelation that Cyril Burt's data on the intelligence of identical twins reared apart were fraudulent demonstrates

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a. that fraudulence is more likely to occur in the social than in the natural sciences.
b. how the public scrutiny of scientific research contributes to scientific "objectivity."*
c. that social research findings should have no bearing on public policy.
d. some areas of social research tend to attract unethical scientists.

38. One "reality" of social scientific inquiry is that, in comparison with the natural sciences,

a. theoretical knowledge is less developed in the social sciences.*
b. personal values and biases have a greater impact because social scientists are more passionate about their work.
c. the social sciences are more likely to involve collaborative research.
d. the social sciences seldom use methods to control for error and bias.

39. Which of the following statements is *false*?

a. Theoretical knowledge is less developed in the social than in the natural sciences.
b. There is inevitably some degree of error in scientific prediction.
c. It is usually possible to eliminate the influence of personal values and biases in scientific work.*
d. Some sociologists challenge the scientific conception of sociology and other social sciences.

40. Which type of theoretical explanation is favored by qualitative researchers?

a. idiographic explanation*
b. nomothetic explanation
c. universal explanation
d. abstract causal explanation

41. Which of the following is *not* among qualitative researchers' criticisms of using the natural sciences as a model for social scientific inquiry?

a. Knowledge is a social construction that differs from objective reality.
b. Explanations of the social world are limited by culture and time.
c. Human activities cannot be quantified.*
d. Studying humans, as opposed to nonhuman objects, requires an understanding of the subjects' interpretations of the world.

True and False

T* F 1. The principal goal of science is to produce knowledge.

T F* 2. The principal goal of science is the solution of technical and social problems.

T F* 3. In science, as in everyday language, it is acceptable for a concept to have multiple meanings.

T* F 4. A concept is an idea or abstract notion usually communicated by words.

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T F* 5. Explanation and prediction in science involve different forms of logical reasoning.

T* F 6. Theories provide a more general understanding than scientific laws.

T* F 7. It is possible to have prediction without scientific understanding.

T F* 8. The confirmation of a particular prediction is sufficient to prove a theory.

T* F 9. In science, evidence is always open to change through reinterpretation or possible contradiction by new evidence.

T* F 10. Scientific knowledge is tentative and uncertain.

T F* 11. Science is best defined as a step-by-step method of data collection.

T F* 12. The scientific process always begins with theory and ends with data.

T F* 13. Scientific inquiry always starts with data, from which theories are developed.

T* F 14. Science involves both deductive and inductive reasoning.

T* F 15. In inductive reasoning, conclusions may go beyond the evidence at hand.

T F* 16. Inductive reasoning generally represents a top-down process, moving from theory to hypothesis to data.

T* F 17. In formulating a hypothesis from a theory, a researcher uses deductive reasoning.

T* F 18. Several theories may account for the same empirical patterns.

T* F 19. Empirical evidence is observable to the researcher and others.

T F* 20. Like many other intellectual endeavors, scientific inquiry relies on tradition, revelation, and intuition as sources of evidence.

T* F 21. Objectivity in science basically boils down to agreement among independent observers of the same event.

T* F 22. The public nature of science safeguards scientific objectivity.

T F* 23. Theories must generate highly accurate predictions to be scientifically useful.

T* F 24. Scientists may adhere to major theories for long periods in the face of much contradictory evidence.

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T* F 25. Qualitative researchers tend to reject the natural sciences as a model of social scientific inquiry.

T F* 26. Qualitative researchers tend to assume that there is an objective reality that exists independent of the investigator.

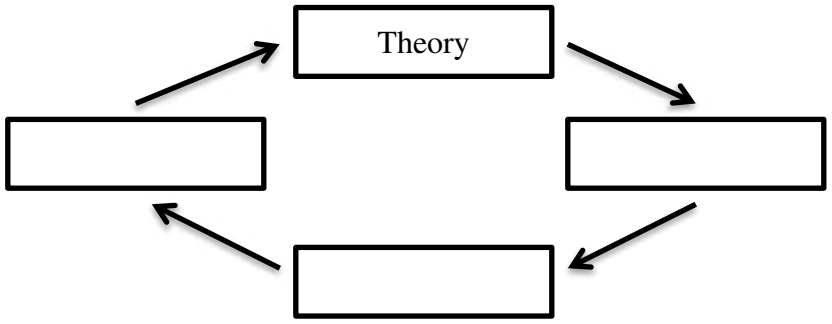
T* F 27. According to the text, both nomothetic and idiographic explanations have a place in social scientific inquiry.

Essay

1. The textbook describes science as a "product" and a "process." What is the essential defining product of science? What is the best overall description of the scientific process?

2. Describe how Durkheim used both deductive and inductive reasoning in his study of suicide. Be sure to give specific details of the study as these relate to each form of reasoning.

3. Below is an outline of a flowchart illustrating the scientific process. Fill in the boxes and then indicate whether each arrow in the diagram represents the application of deductive or inductive reasoning.



4. Because of the human element in science, some scholars believe that it is impossible to detect and eliminate sources of bias in scientific inquiry. Present a rebuttal to this criticism. Be sure to point out how biases and errors often are identifiable and correctable because the nature of scientific inquiry enables its own critique.

5. What are the three epistemic assumptions of qualitative research that challenge the natural sciences model of social science? How do the textbook authors counter these challenges?

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CHAPTER 2

The Nature of Science

Lecture and Demonstration Ideas

1. Measuring and Challenging Student Images of Science

Chapter 2 opens with a discussion of student images of scientists that is based on a class demonstration that I used for many years. Toward the end of the first class meeting, as preparation for a lecture and discussion on science, I have asked students to respond in writing to the following sentence completions:

1. When I think about a scientist, I think of . . .
2. If I were going to be a scientist, I would like to be the kind of scientist who . . .
3. If I were going to be a scientist, I would not like to be the kind of scientist who . . .
4. When I think of a social scientist [or sociologist], I think of . . .

I ask the questions orally and collect students' responses. Then, at the next class meeting, I briefly summarize the students' responses, which I use to generate a discussion of the nature of science.

The first three questions are drawn from a study of the image of the scientist among American high school students that was conducted in the mid-1950s by Margaret Mead and Rhoda Metraux (1962). Based on answers to these questions from a national sample, the "shared image" of the scientist included the following, stated in the sex-biased language of that time (Mead and Metraux, 1962:236–38):

> Science is natural science with little direct reference to [people] as social being[s] except as the products of science . . . affect [their lives.]
>
> The scientist is a man who wears a white coat and works in a laboratory. He is elderly or middle aged and wears glasses. . . . He may wear a beard, may be unshaven and unkempt.
>
> He is surrounded by equipment: test tubes, Bunsen burners, flasks and bottles, a jungle gym of blown glass tubes and weird machines with dials.
>
> He spends his days doing experiments. He pours chemicals from one test tube into another. He peers raptly through microscopes. He scans the heavens through a telescope. . . . He experiments with plants and animals, cutting them apart, injecting serum into animals. He writes neatly in black notebooks.

In addition to this shared portrait, Mead and Metraux found divergent positive and negative perceptions that were near mirror images of one another. The positive image, for example, described the scientist as a very intelligent person who has many years of education and training. The scientist takes his or her work seriously, is patient, careful, and dedicated, and works long hours in the laboratory to produce results that may promote the general welfare. On the negative side, the scientist was seen as a "brain" who works in a laboratory on dull and tedious tasks that may produce fruitless results even after years of work. Further, the scientist often works alone and is so involved in work that he or she has few other interests or friends, no social life, and is never home.

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Using a very different methodology, David Beardslee and Donald O'Dowd (1962) found that the image of the scientist among college students circa 1960 resembled in many ways the preceding image held by high school students. Moreover, my analysis of 144 questionnaires collected in six research methods classes from fall 1989 to spring 1996 suggests that this image changed very little in the last half of the twentieth century (see Singleton, 1998). Responses to the first question revealed that virtually all students associated science first and foremost with natural science; 32 percent made specific reference to the "laboratory" *or* to laboratory paraphernalia, such as test tubes and Bunsen burners, *or* envisioned the scientist in a "white lab coat"; another 8 percent mentioned a specific natural science field; and an additional 10 percent identified a specific natural scientist, such as Charles Darwin, Sir Isaac Newton, or Albert Einstein.

Physically, 11 percent pictured someone with glasses or goggles, and a few described someone who was "old" and "white-haired" or had "wild hair" (another 10 percent identified Albert Einstein, presumably conveying a similar physical image). Eleven percent saw the scientist as intelligent and/or well educated; a few mentioned curious and dedicated or hard working. Finally, this question, in addition to question 3, evoked a negative psychological image from a few students, who saw the scientist as unable to relate to others, as obsessive about work, and/or as eccentric, weird, or mad.

To begin the class discussion, I tell students that there are no right or wrong answers to the exercise—that it is not a test. Rather, I was merely gathering information about their images of science in the manner of a social scientist. Of course, some of their images may not correspond with what is known about scientists. I then briefly summarize their answers. Finally, we discuss what science is and is not. The exercise facilitates a discussion of several key points:

First, the label "scientist" seems to be reserved for natural scientists—primarily chemists, physicists, and biologists—as it does not readily conjure up images of sociologists or other social scientists. Yet, a main point of Chapter 2 is the unity of natural and social science. What are the defining characteristics of all sciences? Why is sociology seldom recognized as a science?

Second, the professional image of the scientist is primarily that of a researcher, more specifically, an experimenter. Students also mention invention, discovery, exploration, and data analysis as other activities. However, students rarely think of *theorists* when they think of scientists, and they seem to see the source of scientific knowledge as hard work rather than imagination. Noting this aspect of students' image can provide a lead-in to a discussion of the centrality of theory in science and to the importance of imagination in all phases of scientific work.

Third, several facts gleaned from this exercise suggest that most sociology majors have no intention of making science a part of their lives. When my students thought of social science, they tended to think of what sociologists study and less often of research or *how* sociologists produce knowledge. Most of the students had taken few, if any, college courses in the natural sciences. And if they did not express openly hostile images of the scientist, many students attributed traits that they themselves would not want to possess. To many students, the typical scientist is hard-working to an extreme, is unsociable, and downright strange. Such attitudes no doubt shape many students' expectations about a course in research methods and could be challenged in several ways. One could point out the pleasures of doing social scientific work—the rewards of intellectual activity in itself, the joy of perceiving regularities and connections in

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the social world, the anticipation of gathering data to test suspected relationships, and the excitement of having one's hypotheses supported. One also could note that science is very much a social activity—that collaboration is the norm in scientific work and that by its very nature, science involves the constant sharing of knowledge.

2. Using the GSS to Discuss Perceptions and Reality of Science

As an alternative to the first lecture/demonstration idea, instructors could discuss GSS results from a 2012 module on science. The text points out that the public generally associates science with (1) natural and not social science and (2) research and not theory. To further illustrate these points, one could compare results of GSS questions asking how scientific the fields of biology (BIOSCI), physics (PHYSCSCI), sociology (SOCSCI), and economics (ECONSCI) are, and present the results of an open-ended GSS question asking respondents to express in their own words "what it means to study something scientifically" (SCITEXT).

To expand the discussion, instructors could hand out a brief questionnaire that asks students to respond to GSS items that examine public perceptions of science. Then, after revealing that the questionnaire items were included in a national survey, one could present the results and ask students to speculate about the reasons for the response patterns, which suggest several prevailing stereotypes. Consistent with patterns found in the demonstration described above, GSS results showed that a sizeable minority of respondents agreed that a job as a scientist would be boring (18.5%), scientists have few other interests but their work (35.7%), scientists are apt be odd and peculiar people (36.9%), and scientists don't get as much fun out of life as other people do (25.7%). Almost 40 percent of the public also agreed that scientists are not likely to be very religious people. On the positive side, well over 90 percent agreed that scientists are dedicated people who work for the good of humanity and most scientists want to work on things that will make life better for the average person.

The GSS also asked respondents where they get most of their information about science and technology (SCIFROM), which could explain sources of the public's perceptions of science. Indeed, it seems likely that students will mention one or more of these sources as the basis for prevailing beliefs. Thus, instructors could present a few crosstabs in which SCIFROM is the independent variable. When we recoded this variable to create fewer categories and ran a few crosstabs, we found that that those who used TV and radio as their main sources of information were more likely to agree with various stereotypes than those who use the Internet or print media.

3. Simulating and Stimulating Scientific Thinking

There are several interesting ways to demonstrate the process of scientific inquiry (see, for example, Hatcher, 1990, and Bates, 1991). My personal favorite is an exercise suggested by Blaine Peden and Allen Keniston (1987) that uses a version of the card game Eleusis to simulate aspects of scientific inquiry and discovery as it stimulates students to think scientifically. The exercise requires a deck of cards, and if you do it with the entire class, as I have done, it helps to have an oversized deck.

You begin the exercise by placing four cards—the jack of clubs, three of diamonds, king of clubs, and seven of diamonds—in a row from left to right on the board or on a table. Peden and Keniston suggest that you tell students that their goal is to discover the "rule" that explains the

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pattern. You then solicit possible rules, or alternative hypotheses, and write them on a chalkboard. The most apparent rules include: (1) alternate colors (black, red, black, red); (2) alternate pictures and numbers (face card, number, face card, number); (3) alternate suits (club, diamond, club, diamond); and (4) alternate higher and lower cards (high, low, high, low). Once students understand that different rules could produce this particular pattern (i.e., that various alternative hypotheses or theories could produce the same sequence of events), you ask them to choose which rule they think is correct and to test it by conducting an experiment. Telling the class that you have assumed the role of Mother Nature, so that you know what the rule is, you ask them to select a card from the deck. If the card fits the rule, then you indicate that the experiment was successful and place the card to the right of the seven of diamonds; if the card does not fit, then you indicate that the experiment failed and place the card beneath the seven of diamonds (more generally, beneath the last successfully played card).

This exercise beautifully demonstrates several aspects of scientific investigation. For example, students experience each stage in the cycle of data or observation, hypothesis, experiment or test, and interpretation. Students use inductive reasoning as they imagine alternative hypotheses, and they must use deductive reasoning to derive appropriate experimental tests. Because successful tests invariably confirm more than one alternative hypothesis, students also learn the importance of disconfirmation, replication, and cumulative understanding. (See Peden and Keniston, 1987, for further discussion of the richness of this metaphor.)

4. Teaching about Logical Reasoning in Science

For instructors who would like to elaborate on the text's discussion of logical reasoning in science, a useful source of ideas is Chapter 3, "The Logic of Scientific Reasoning," in Singleton and Straits' *Approaches to Social Research*, 3rd edition, which is available online (http://college.holycross.edu/projects/approaches5/PDFs/chap2.pdf). Instructors may draw on this chapter to discuss valid and invalid forms of deductive arguments, factors affecting the strength of inductive generalizations, and how inductive reasoning applies to hypothesis testing.

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Singleton, R. A., Jr. 1998. Is sociology a science? A classroom exercise for promoting discussion. Paper presented at the annual meeting of the American Sociological Association, San Francisco.

Exercises

1. Understanding the Nature of Theory by Reading the Literature

Perhaps the best way for students to understand theory and its place in scientific inquiry is to read published research. For example, we have assigned an article reporting a study by Ronald Inglehart and Wayne Baker (2000), which uses data from the World Values Surveys to examine the relationship between modernization, cultural traditions, and persistence and change in basic values. The article has a particularly rich theoretical framework focusing on modernization theory and its critics. We recommend that instructors assign an abridged version of this article found in Dixon and Singleton (2013:5–16). Below are questions students could address after reading the article.

a. According to Marx's modernization theory, industrialization brings about predictable cultural and social changes. Give one example of these changes. What economic development, shown first in the United States, suggests that cultural change did not follow the "simple linear path envisioned by Marx"?
b. Explain how the enduring influence of traditional religious values challenges modernization theory.
c. How, according to Inglehart and Baker, did the results of their study show that "modernization theorists are partly right"?
d. Based on study results, what revisions do the researchers propose to modernization theory? What does this illustrate about the relationship between research and theory?

2. Identifying Theory/Theories in Research Articles

Using your college library website, find the research database SocINDEX. Do a search of this database by entering *American Sociological Review* and indicating that this is the publication name. The search will generate a lengthy list of articles, beginning with the most recently published. Nearly all colleges and universities will subscribe to this journal and, therefore, you will find PDF copies of the articles. Find the first listing with a PDF copy available (copies of very recently published articles may not be available yet). Open the PDF copy and read the introductory sections of the article to identify the theory or theories that the reported study examines. Briefly describe the theory or theories that you identify. Repeat this process for four additional articles.

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Inglehart, R., and W. E. Baker. 2000. Modernization, cultural change, and the persistence of traditional values. *American Sociological Review* 65:19–51.

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Web Resources

This is Science! (http://www.ucmp.berkeley.edu/people/jlipps/science.html)

In this 12-page essay, UC Berkeley biologist Jere Lipps lucidly describes the nature of science. Particularly useful are tables showing the skills involved in critical thinking and evidential reasoning, which are the backbone of scientific inquiry.

ScienceBlogs (http://scienceblogs.com/)

This fascinating site was created to provide a dialogue about science and the contemporary world. Contributors from a wide array of scientific disciplines debate new scientific insights and discoveries and the interplay between science and politics, religion, philosophy, business, and the arts. In February 2017, there were posts on the politicization of science and the scheduled March for Science, to take place on Earth Day in Washington, DC, a study showing that food packaging contains chemicals harmful to human health and the environment, and resources for debunking and learning about climate change deniers.

Veritasium (https://www.youtube.com/user/1veritasium)

As described in the site trailer, Veritasium is a science video blog "featuring experiments, expert interviews, cool demos, and discussions with the public about everything science." In a January 2015 video blog "Why Technology Fails to Revolutionize Education," Derek Miller offers his thoughts on why technology in the classroom does not enhance learning. Other videos include "Can Silence Actually Drive You Crazy" and "The Most Radioactive Places on Earth."

The American Association for the Advancement of Science (http://www.aaas.org/)

Publisher of the journal *Science*, AAAS is an international nonprofit organization dedicated to advancing science around the world for the benefit of all people. The home site includes links for educators and students, although many of the resources are for teaching science in grades K–12. A useful link is the AAAS Policy and Public Statements page, which contains links to statements on such topics as climate change, stem cell research, and the civil dialogue between science and religion.

Case Study Teaching in Science (http://sciencecases.lib.buffalo.edu/cs/)

This site offers numerous case studies with explanations of their uses. According to the site overview, case studies are "a powerful pedagogical technique for teaching science. Cases can be used not only to teach scientific concepts and content, but also process skills and critical thinking. And since many of the best cases are based on contemporary, and often contentious, science problems that students encounter in the news, the use of cases in the classroom makes science relevant." One may select cases from several different scientific disciplines, including psychology, and many cases are based on contemporary science problems that are in the news (e.g., human cloning, AIDS, acid rain).

Science Is Not About Certainty (http://www.newrepublic.com/article/118655/theoretical-phyisicist-explains-why-science-not-about-certainty)

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In this essay on the nature of science, the author underscores an important conclusion of Chapter 2 about the nature of science: "Science is not about certainty." As the author notes, "The very expression 'scientifically proven' is a contradiction in terms." Although current scientific knowledge may be effective, it is basically the best and most credible knowledge we have so far, and any part of it is open for revision.

iLogic (http://www.butte.edu/~wmwu/iLogic/iLogic.html)

A free online textbook on introductory logic, this resource provides an excellent overview of deduction and induction, among other topics. Section 1.3, Deduction and Induction (Go to the Table of Contents) provides concise definitions and examples of deductive and inductive arguments, and discussions of validity and soundness, strength and reliability, and proof versus confirmation, followed by two sets of exercises to test the readers' understanding.

Answers to Selected Textbook Exercises

1. Give examples of scientific and nonscientific questions that could be asked about the following topics: (a) capital punishment, (b) abortion, (c) intelligence.

   Examples of scientific questions: (a) Why is capital punishment legal in some states but not in others? (b) How are attitudes toward abortion related to religious affiliation? (c) How are levels of intelligence related to social class?

   Examples of nonscientific questions: (a) Is capital punishment morally wrong? (b) Should abortion be legalized? (c) Should the selection of police trainees be based on estimated intelligence?

2. Indicate whether each of the following inferences represents *deductive* or *inductive* reasoning.

   a. A survey researcher interviews 2,500 people from a random sample of U.S. adults and finds that 69 percent of them say they are in favor of capital punishment. He concludes that 69 percent of the U.S. adult population favors capital punishment.

      This represents inductive reasoning: The pollster is making an inference that goes beyond the information at hand—from a sample to a population.

   b. The presence of others strengthens people's dominant (prevalent or most likely) responses. If the dominant response is correct, people will perform better in the presence of an audience than when they perform alone. (This is called the "social facilitation effect.") Assuming the latter statements are true, it follows that good pool players will make a higher percentage of their shots when an audience is watching them play than when they are shooting pool by themselves.

      This is an example of deductive reasoning. The inference is from a theory (the social facilitation effect) to a hypothesis. If the theoretical premises are true, the conclusion (or hypothesis) must be true.

   c. Research with University of Hawaii students found that women, Asians, and students living at home were less likely to smoke marijuana than men, non-Asians, and students

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not living at home, respectively. Noting that each of the former groups has more to lose (e.g., is likely to experience more disapproval) from smoking marijuana, the researcher concluded that the more social constraints a student has, the less likely it is that he or she will smoke marijuana.

This is an example of inductive reasoning: An inference is being made from empirical patterns derived from data (i.e., frequency of marijuana use among various groups) to a more abstract conclusion (i.e., a theoretical statement that marijuana use depends on a student's social constraints).

3. You have been listless for the past two weeks. You do not have much of an appetite. Your friends bore you, and you can't seem to get interested in anything. Your grades are beginning to go down. Formulate a hypothesis to account for this situation and then show how the facts of the situation can be deduced from your hypothesis (adapted from Runkle, 1978:281).

   Possible hypotheses are that you are depressed, perhaps over the recent breakup of a romantic relationship, or you are suffering from an unidentified illness. Depression might account for the facts as follows:

   You are depressed (hypothesis).
   If people are depressed, then they will feel listless
   Therefore, you feel listless.

   You are depressed (hypothesis).
   If people are depressed, then they will lose their appetite.
   Therefore, you don't have much of an appetite.

   You are depressed (hypothesis).
   If people are depressed, then they will lose interest in others.
   If people lose interest in others, then their friends will bore them.
   Therefore, if you are depressed, then your friends will bore you.
   Therefore, your friends bore you.

   You are depressed (hypothesis).
   If people are depressed, then they will have a sense of hopelessness.
   If they experience hopelessness, then they will lose ambition.
   If they lose ambition, then they will not do well in school.
   Therefore, if you are depressed, then you will do poorly in school.
   Therefore, you are doing poorly in school.

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