

**OPENING THE
BLACK BOX
OF TEACHING**

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MICHIGAN STATE UNIVERSITY

OBJECTIVES

- ▶ Work in teams to explore the scientific process
- ▶ Apply and test concepts from readings
- ▶ Extend or experiment with course concepts
- ▶ Define science

**ONE QUESTION:
WHAT'S IN THE BOX?**

**ONE RULE:
DON'T OPEN THE BOX**

THE OBJECTIVE

- ▶ Hardcastle and Slater: provide a “toy” science experience for non-majors to gain enough confidence to make critical judgments about science.
- ▶ Me: provide science majors an occasion for radical reflection and self-discovery.
 - ▶ Students work hard to figure out what is inside the box, but the real project is in constructing a social structure outside of the box to determine when a suitable answer has been found.

MODEL ONE: INTENSIVE INVESTIGATION

- ▶ Four weeks of intensive work, both in and out of class
- ▶ Requires some work to align readings and box exercises and reflections
- ▶ Requires fair amount of class time
- ▶ Requires fair amount of group work outside of class
- ▶ Enables longer-term engagement and reflection
- ▶ Enables connection to more materials

MODEL TWO: TWO WEEK, IN-CLASS

- ▶ Allows for carefully managed engagement
- ▶ Enables surfacing of “invisible” features of investigation
- ▶ Requires fair amount of class time
- ▶ Does not require out-of-class work

MODEL THREE: OCCASIONAL EXERCISES

- ▶ Can be entirely in-class
- ▶ Relatively low investment of planning

NEGOTIATING RULES OF CONDUCT

- ▶ What does “don’t open the box” mean?
 - ▶ Structural integrity, tape, poking through openings, x-rays
- ▶ When should groups share results?
 - ▶ At end, throughout, at “conferences”
- ▶ How can we trust the claims of other groups?
- ▶ Should groups be allowed to use special equipment?

JUDGING RESULTS

- ▶ Who is qualified to judge results?
 - ▶ Instructor, students, past students, panel of scientists/experts
- ▶ What criteria should count?
 - ▶ aims, reasoning, methods, quantity of data,
 - ▶ creativity, persuasiveness, humility, acknowledgement of assumptions

EXAMPLE CONCEPT: REALISM/ANTIREALISM

- ▶ Do students want to find out what's really in there?
- ▶ Are there practical aims to scientific inquiry? Are there limits?
 - ▶ "baby" box creature
 - ▶ cure
 - ▶ fundamental particles

EXAMPLE CONCEPT: NORMS, COUNTERNORMS, AND BOUNDARY WORK


- ▶ Classes debate whether to adopt universalism, communism, disinterestedness, organized skepticism – or if they wish to accept counter-norms of particularism, solitariness, interestedness, or dogmatism
- ▶ Classes discuss how their norms should be enforced
- ▶ Groups internally debate whether they want to live up to the norms or subvert them.
- ▶ When judging the results of other groups, a group explicitly considers whether they have lived up to norms

OTHER CONCEPTS

- ▶ Aims of science
- ▶ Scientific explanation
- ▶ Experimenter's regress
- ▶ Diversity
- ▶ Experimental design
- ▶ Uncertainty
- ▶ Science & Policy
- ▶ Discovery & Invention
- ▶ Social construction
- ▶ Styles of reasoning
- ▶ Multimodal evidence
- ▶ Values in science
- ▶ Scientific ethics
- ▶ Expertise

BLACK BOX CHALLENGE


STUDENT APPROACHES



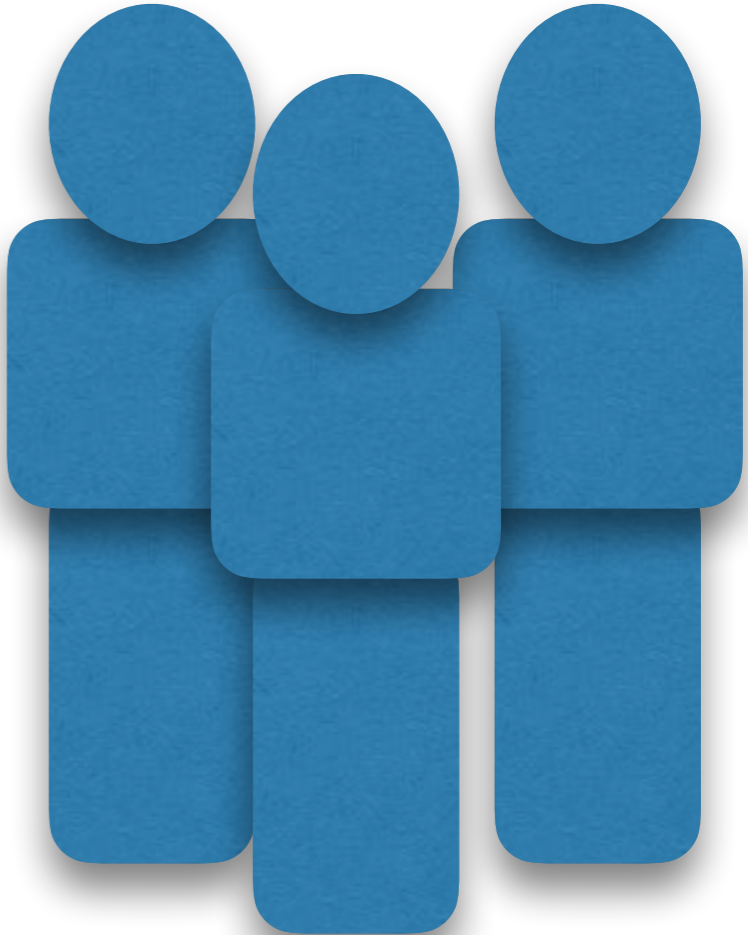
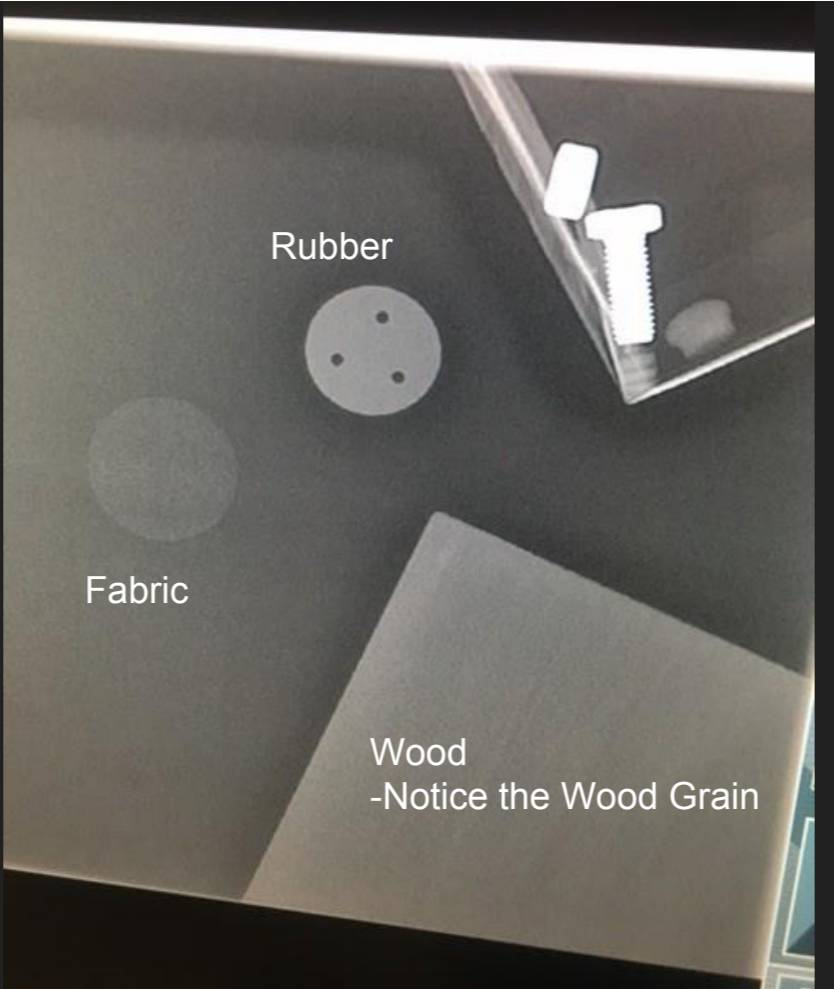
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100 pack
D Dia.



WE CANNOT KNOW FOR SURE WHAT IS IN THE BOX. WE ELECT NOT TO MAKE GUESSES ABOUT WHAT'S IN THERE. INSTEAD, WE'LL TELL YOU ABOUT THE PROPERTIES OF THE BOX-AS-A-WHOLE.

The Antirealists



WE PUT A MAGNET ON A STRING AND HAULED ITEMS OUT OF THE SEAMS. REPEAT WITH TWO-SIDED TAPE.

The Fishers



WE HAVE SPECIAL ACCESS TO {X-RAYS,
ENDOSCOPE, CT SCANNER} AND WE'RE NOT
SHARING.

“We know a guy”



WE BOUGHT A BOX OF SIMILAR SIZE AND RANSACKED OUR PARENTS' JUNK DRAWERS FOR LIKELY BOX CONTENTS. WE DID A SERIES OF COMPARISON TESTS AND RULED OUT A NUMBER OF OBJECTS.

The Modelers



WE CANNOT KNOW FOR SURE WHAT IS IN THE BOX. WE ELECT NOT TO MAKE GUESSES ABOUT WHAT'S IN THERE. THERE ARE NO PRACTICAL AIMS ASSOCIATED WITH FIGURING OUT MORE ABOUT THE BOX. THEREFORE, WE OPT TO BASICALLY IGNORE THIS ASSIGNMENT.

The Fatalist Antirealists



THERE ARE 10 BOXES. WE REASON THAT DR. RECORD IS NOT INDEPENDENTLY WEALTHY AND HE WOULD NOT KNOWINGLY PUT US IN PHYSICAL OR LEGAL DANGER. THEREFORE, WE CONCLUDE THERE ARE NO HIGHLY FLAMMABLE, TOXIC, OR PSYCHEDELIC SUBSTANCES IN THE BOX AND THAT THE ITEMS ARE HOUSEHOLD ITEMS.

The Psychologists



ALTHOUGH OUR CLASS HAS EXPLICITLY DECIDED NOT TO WEIGH CHARISMA, WE HAVE CONCLUDED THAT IT IS IMPOSSIBLE TO AVOID JUDGING BASED ON CHARISMA, AND HAVE GONE ALL IN, SHOWING OUR CREDENTIALS, GRACIOUSLY ACKNOWLEDGING INSPIRATION FROM OTHER TEAMS, AND PAIRING OUR EXPERIMENTAL RESULTS WITH IMPRESSIVE PHOTOGRAPHS OF OURSELVES IN TRIUMPHANT POSES (WITH A SMALL PLANE, HOLDING A TROPHY, ETC.)

The Performers



BLACK BOX CHALLENGE

RUBRIC

	Exemplary	Proficient	Developing
Methods	Clearly conveys carefully planned investigation, producing compelling evidence	Conveys promising methods, producing appropriate evidence	Methods and evidence seem hasty, undeveloped
Reasoning	Appropriately draws relevant conclusions from evidence, including course materials	Appropriately draws from some evidence and some course materials	Evidence used, not always appropriate
Conclusions	Compelling conclusions	Conclusions seem accurate given evidence	Conclusions do not always connect to evidence in a compelling way
Organization	Organization enhances development of theory of box	Ordering of presentation is logical and generally supports development of theory	Ordering of presentation somewhat logical. Sporadically helps develop theory
Engaging	Confident, persuasive delivery	Generally believable delivery	Overly hesitant or boring delivery

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