

Appendix 3-B
APS Engineering Task Protocols and ETD Data Sets

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Problem-Scoping Task Protocol (2004)

INSTRUCTIONS:

At this time, I'd like to ask you to work on a short activity. While I hope that it is a fun activity for you, I would also like you to give it your best effort. You have up to ten minutes to work on it. Please let me know if you are done before that. Do you have any questions? OK, here is the activity—I'm going to read it with you, out loud (CHECK START TIME ON AUDIO RECORDER AND INDICATE IT IN THE BOX BELOW. THEN HAND R THE PROBLEM-SCOPING TASK FORM.).

Start time:

PTQ1: (NEXT READ THE FOLLOWING ALOUD TO R) Over the summer the Midwest experienced massive flooding of the Mississippi River. What factors would you take into account in designing a retaining wall system for the Mississippi?

TRANSITION:

(CHECK END TIME ON AUDIO RECORDER, AND IF NECESSARY): *Okay, it's been 10 minutes now, please stop.*

End time:

PTQ2: What questions came to your mind as you were brainstorming your list?

(THE QUESTIONS NEED TO BE FULLY FORMULATED. IF R OFFERS A FRAGMENT AS A QUESTION, INSTRUCT HIM/HER TO CLARIFY HOW HE/SHE USED IT IN A QUESTION AND TO STATE THE FULL QUESTION. IT IS OKAY FOR R TO BROWSE THROUGH THE LIST OF FACTORS HE/SHE HAS WRITTEN, BUT THERE IS NO NEED TO SUGGEST THIS IN YOUR INSTRUCTIONS. R SHOULD BE ABLE TO PROVIDE 5-10 QUESTIONS IN 2-3 MINUTES.)

TRANSITION:

(COLLECT PAPER) *Great! Thank you. We hope that you've enjoyed this activity and we want to make sure that you know that there are many right answers. We've used it to collect information from engineering students across the nation to understand the types of things students think about.*

Performance Task (2005)

INSTRUCTIONS:

At this time, I'd like to ask you to work on a short activity. This is the kind of activity that has many different kinds of answers. We would like you to give it your best effort. You have up to fifteen minutes to work on it. I will let you know when there is five minutes left, so you have an idea about how much time has passed. Please let me know if you are done before the fifteen minutes is up. Do you have any questions? OK, here is the activity. (CHECK START TIME ON AUDIO RECORDER AND INDICATE IT IN THE BOX BELOW. THEN HAND R THE PERFORMANCE TASK FORM.).

Start time:

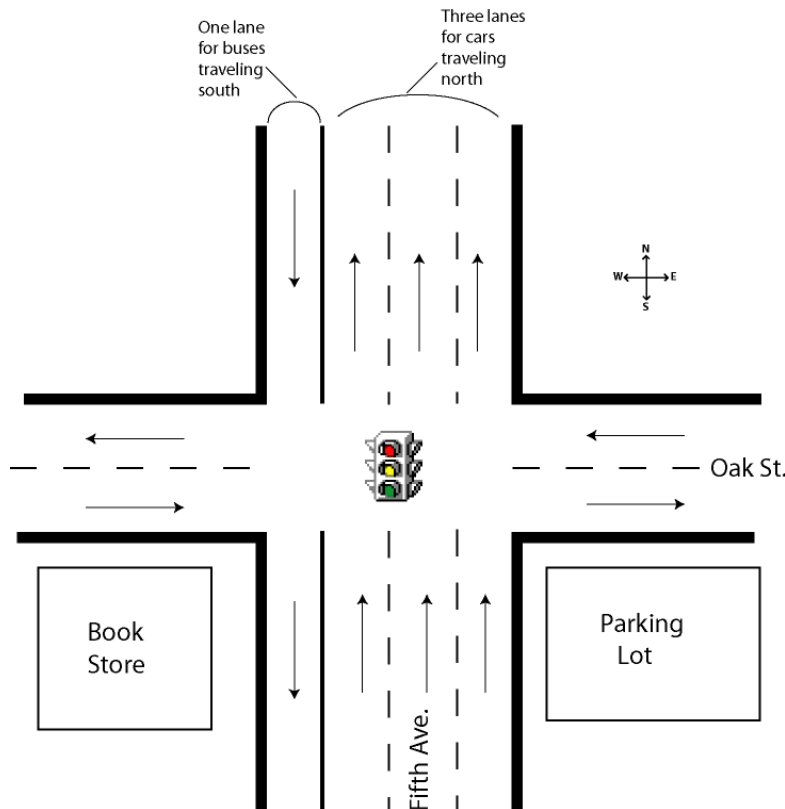
RECORD TIME HERE

PTQ1. (ALLOW THE STUDENT TO READ AND SOLVE THE PROBLEM ON THEIR OWN)

Respondent ID: _____

As an engineer, you have been asked to solve a problem on the State University campus. Just like campuses across the country, the State University campus is often overcrowded with pedestrians crossing the streets.

One busy intersection on campus is the crossing of Fifth Ave. in front of the bookstore. Dangers at this intersection include heavy traffic and busses which run against the general traffic flow (see diagram below). The University would like to design a cost effective method for students to cross Fifth Ave. which would reduce the possibility of accidents at this intersection. You have been assigned to design a solution to this problem for presentation to the University Traffic Committee.



In the process of designing your solution you have been asked to respond to the set of questions on the following pages. The interviewer has more paper if you need it.

1 – What is the problem as you see it?

2 – List potential solution(s) for this problem.

3 – From your list in Question 2, choose the potential solution you think is best and provide a detailed evaluation of your solution.

4 – What kinds of additional information would help you solve this problem?

TRANSITION:

(CHECK END TIME ON AUDIO RECORDER, AND IF NECESSARY):

Okay, it's been 10 minutes now; you have 5 more minutes to solve the problem.

Okay, it's been 15 minutes now, please stop.

End time:

RECORD TIME HERE

PTQ2. What questions came to your mind as you were solving the problem? Please voice your thoughts in the form of questions as if you are playing Jeopardy.

(THE QUESTIONS **MUST** BE FULLY FORMULATED. IF **R** OFFERS A FRAGMENT AS A QUESTION, REMIND **R** TO SPEAK AS IF HE/SHE IS PLAYING JEOPARDY, AND ASK **R** TO CLARIFY HOW HE/SHE USED THE FRAGMENT IN A QUESTION. IF **R** IS NOT FAMILIAR WITH JEOPARDY, TELL **R** THAT IT IS OKAY, AND THAT ALL HE/SHE NEEDS TO DO IS TO RESPOND IN QUESTIONS ONLY. IT IS OKAY FOR **R** TO BROWSE THROUGH THE LIST OF SOLUTIONS HE/SHE HAS WRITTEN, BUT THERE IS NO NEED TO SUGGEST THIS IN YOUR INSTRUCTIONS. IF **R** OFFERS 2 QUESTIONS OR LESS, PROMPT HIM/HER AGAIN. **R** SHOULD BE ABLE TO PROVIDE 5-10 QUESTIONS IN 2-3 MINUTES.)

PTQ3. To what extent do you feel this is an engineering problem?

PTQ3a. (IF NOT ALREADY ANSWERED) And why?

PTQ4. What knowledge and skills helped you solve the problem?

PTQ5. Where did you develop your knowledge and skills to solve the problem?

PTQ5a. (IF NOT ALREADY ANSWERED) Please describe those experiences in more detail.

PTQ6. Did you feel confident in your ability to complete this task?

PTQ6a. (IF NOT ALREADY ANSWERED) And why?

TRANSITION:

(COLLECT PAPER) *Great! Thank you. We hope that you've enjoyed this activity and we want to make sure that you know that there are many right answers. We've used it to collect information from engineering students across the nation to understand the types of things students think about.*

Performance Task (2006)

TRANSITION FOR ETHNOGRAPHIC INTERVIEWS:

The last part of today's session has a different format from the interview we just completed. I will be reading instructions and questions from a script.

INSTRUCTIONS:

At this time, I'd like to ask you to work on a short activity. While I hope that it is a fun activity for you, I would also like you to give it your best effort. You have up to ten minutes to work on it. Please let me know if you are done before that. Do you have any questions?

OK, here is the activity—I'm going to read it with you, out loud. You might remember this activity if you were asked to do it two years ago as part of this study. (CHECK START TIME ON AUDIO RECORDER AND INDICATE IT IN THE BOX BELOW. THEN HAND R THE PERFORMANCE TASK FORM.).

Start time:

:	:
HH	MM SS

PTQ1: (NEXT READ THE FOLLOWING ALOUD TO R) Over the summer the Midwest experienced massive flooding of the Mississippi River. What factors would you take into account in designing a retaining wall system for the Mississippi?

TRANSITION:

(CHECK END TIME ON AUDIO RECORDER, AND IF NECESSARY): Okay, it's been 10 minutes now, please stop.

End time:

PTQ2: What questions came to your mind as you were brainstorming your list?

(THE QUESTIONS MUST BE FULLY FORMULATED. IF R OFFERS A FRAGMENT AS A QUESTION, REMIND R TO SPEAK AS IF HE/SHE IS PLAYING JEOPARDY, AND ASK R TO CLARIFY HOW HE/SHE USED THE FRAGMENT IN A QUESTION. IF R IS NOT FAMILIAR WITH JEOPARDY, TELL R THAT IT IS OKAY, AND THAT ALL HE/SHE NEEDS TO DO IS TO RESPOND IN QUESTIONS ONLY. IT IS OKAY FOR R TO BROWSE THROUGH THE LIST OF SOLUTIONS HE/SHE HAS WRITTEN, BUT THERE IS NO NEED TO SUGGEST THIS IN YOUR INSTRUCTIONS. IF R OFFERS 2 QUESTIONS OR LESS, PROMPT HIM/HER AGAIN. R SHOULD BE ABLE TO PROVIDE 5-10 QUESTIONS IN 2-3 MINUTES.)

(IF YOU HAVE A YEAR 1 MIDWEST FLOODS WRITTEN RESPONSE FOR **R**, GIVE IT TO THEM AND PROCEED TO PTQ3. IF NOT, SKIP AHEAD TO PTQ5, WHICH IS MARKED WITH A ▼.)

Here's a copy of your list of factors from back in 2004, when you first did the Mississippi flooding activity.

PTQ3: Take a look at both the response you just wrote today and your response from two years ago. What similarities and differences do you notice between the two responses?

PTQ4: You've told me a little about how your responses are similar or different. How about how you came up with them? Consider how you thought about the activity and how you came up with the factors you wrote down, both today and two years ago. What similarities and differences do you notice?

(IT'S FINE IF **R** ALREADY BEGAN COMPARING THOUGHT PROCESSES (VS. COMPARING RESPONSES) IN ANSWERING THE PREVIOUS QUESTION (PTQ3). ASK THEM TO CONTINUE, E.G., "*Do you notice any other similarities or differences in the way you came up with your response?*")



PTQ5: Have you had any past experiences that helped you do the written activity?

(IF SO, ASK **R** TO DESCRIBE THE EXPERIENCES.)

PTQ6: Have you had any educational experiences that helped you do this activity?

(IF SO, ASK **R** TO DESCRIBE THE EXPERIENCES. **R** MIGHT HAVE ALREADY DISCUSSED EDUCATIONAL EXPERIENCES IN RESPONDING TO PTQ5. IF SO, ASK THEM TO CONTINUE, E.G., "*Are there any other educational experiences that helped you do the activity?*", OR ASK FOR ADDITIONAL DETAILS ABOUT THE EDUCATIONAL EXPERIENCES, IF TIME PERMITS.)

(IF YOU DID HAVE A YEAR 1 MIDWEST FLOODS WRITTEN RESPONSE FOR **R**, SKIP AHEAD TO THE CLOSING TRANSITION BELOW, MARKED WITH A ■.)

TRANSITION FOR STUDENTS WHO DID NOT DO THE ACTIVITY IN YEAR 1:

Now, I'd like to ask you some questions about a recent natural disaster in the U.S.

*PTQ7: How familiar are you with Hurricane Katrina and the flooding in New Orleans?
Could you tell me what you know about these events?*

*PTQ8: Did what you know about these events affect how you approached the
Mississippi flooding activity today?*

(IF SO, ASK **R** TO DESCRIBE HOW THEIR KNOWLEDGE AFFECTED THEIR APPROACH TO THE ACTIVITY.)

CLOSING TRANSITION FOR ALL STUDENTS:

(COLLECT BOTH 2004 AND TODAY'S RESPONSE PAGES.) *Great! Thank you. We hope that you've enjoyed this activity and we want to make sure that you know that there are many right answers. We've used it to collect information from engineering students across the nation to understand the types of things students think about.*

Performance Task 2007

TRANSITION FROM ETHNOGRAPHIC INTERVIEW:

The last part of today's session has a different format from the interview we just completed. I will be reading instructions and questions from a script.

INSTRUCTIONS:

*At this time, I'd like to ask you to work on a short activity. This is the kind of activity that has many different kinds of answers. We would like you to give it your best effort. You have up to fifteen minutes to work on it. I will let you know when there is five minutes left, so you have an idea about how much time has passed. Please let me know if you are done before the fifteen minutes is up. Do you have any questions? OK, here is the activity. You might remember this activity if you were asked to do it two years ago as part of this study. (CHECK START TIME ON AUDIO RECORDER AND INDICATE IT IN THE BOX BELOW. THEN HAND **R** THE FOUR-PAGE PERFORMANCE TASK PACKET.)*

Start time:

:	:
HH	MM SS

PTQ1. (ALLOW THE STUDENT TO READ AND SOLVE THE PROBLEM ON THEIR OWN)

TRANSITION:

(CHECK END TIME ON AUDIO RECORDER, AND IF NECESSARY):

Okay, it's been 10 minutes now; you have 5 more minutes to solve the problem.

Okay, it's been 15 minutes now, please stop.

End time:

:	:
HH	MM SS

(IF YOU HAVE A YEAR 2 STREET CROSSING WRITTEN RESPONSE FOR **R**, GIVE IT TO THEM AND PROCEED TO PTQ2 ON THE NEXT PAGE. IF NOT, SKIP AHEAD TO PTQ4, WHICH IS MARKED WITH A ▼.)

Here's a copy of your responses from back in 2005, when you first did the street crossing activity.

PTQ2: Take a look at both the responses you just wrote today and your responses from two years ago. What similarities and differences do you notice between the two sets of responses?

PTQ3: You've told me a little about how your responses are similar or different. How about how you came up with them? Consider how you thought about the activity and how you came up with the responses you wrote down, both today and two years ago. What similarities and differences do you notice?

(IT'S FINE IF R ALREADY BEGAN COMPARING THOUGHT PROCESSES (VS. COMPARING RESPONSES) IN ANSWERING THE PREVIOUS QUESTION (PTQ2). ASK THEM TO CONTINUE, E.G., "Do you notice any other similarities or differences in the way you came up with your response?")



PTQ4: To what extent do you feel this is an engineering problem?

PTQ4a: (IF NOT ALREADY ANSWERED) And why?

PTQ5: What knowledge and skills helped you solve the problem?

PTQ6: *Where did you develop your knowledge and skills to solve the problem?*

PTQ6a: (IF NOT ALREADY ANSWERED) *Please describe those experiences in more detail.*

PTQ7: *Are there any everyday situations from your life that remind you of the situation described in the problem?*

TRANSITION:

(COLLECT PAPER) *Great! Thank you. We hope that you've enjoyed this activity and we want to make sure that you know that there are many right answers. We've used it to collect information from engineering students across the nation to understand the types of things students think about.*

APS Engineering Thinking & Doing Group data set reference (2008.04.24)

	data set	method	Year			
			1	2	3	4
1a	Engineering design task: Midwest floods	engineering design task	✓		✓	
1b	Engineering design task: Street crossing			✓		✓
2	Most/least important design activities	survey	✓	✓	✓	✓
3	5 terms describing "engineering", "design"	survey	✓		✓	✓
4	Confidence in, course experience with, and course prep. for design activities	survey		✓	✓	✓
5 [†]	Skills important for engineering	structured interview	✓	✓	✓	
6	Perceived importance of engr. knowledge, skills (technical, professional, interpersonal)	survey	✓	✓	✓	✓
7a	Engineering design task: Most/least needed information for playground design	survey	✓			✓
7b	Most/least needed information for typical engineering problem	survey			✓	
8a	Most important skills and knowledge for engineering (from ABET, <i>Engr. of 2020</i> list)	survey			✓	✓
8b	Self assessment of preparation to use engineering skills and knowledge (from ABET, <i>Engr. of 2020 list</i>)	survey				✓
9	5 activities engineers do at work	survey			✓	✓
10a	Importance of various kinds of context in engineering	survey			✓	
10b	Self assessment of preparation to consider various kinds of context in engineering	survey				✓
11	Engineering design task: Five factors important for evaluating silicon chip factory location	survey				✓
12	Experience in academic research and professional engineering	survey				✓
13	Overall academic satisfaction	survey		✓	✓	✓

[†]not an ETD data set; included for reference as potential set for joint analysis with ETD data