

Air Reed

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THIS IS NOT A DEFINITIVE FINAL REPORT

FORMATIVE evaluation studies like this one often:

- **are conducted quickly**, which may mean
 - small sample sizes
 - expedited analyses
 - brief reports

- **look at an earlier version** of the exhibit/program, which may mean
 - a focus on problems and solutions, rather than successes
 - a change in form or title of the final exhibit/program

Sound and Hearing – Formative Evaluation

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PURPOSE

To determine

- which activity is the most interesting for visitors to do at Air Reed,
- which activity is the best in helping visitors interpret what they see, and
- which activity is the best in helping visitors see a connection between this exhibit and flutes, or other fipple instruments.

We looked at three activities:

A (Hand): Place a hand over the tube opening

B (Rod): Use a rod at the notch to direct the air stream

C (Bar): Use a bar to open and close the air stream at the notch (The tube opening was kept closed with a rubber stopper.)

EXHIBIT

- We created a different label to accompany each of the three activities. (Figure 1, Figure 2, Figure 3) Each label gave instructions for using the exhibit, under *Try This*, and included two photographs showing how to use this exhibit. None of the labels gave any explanations about *What's Going On*.
- The following components were labeled on the exhibit:
 - the white screen
 - the notch in the tube
 - the tube opening
- For version A (Hand), the tube opening faced front, as shown in Figure 1.
- For version B (Rod), the tube opening faced back, as shown in Figure 2. We handed the visitor the rod to play with at the start of his/her interview.

- For version C (Bar), the tube opening faced back and a rubber stopper was used to close off the tube opening. See Figure 3. At the start of each visitor's interview, we placed the bar in the notch so that it deflected the air stream and the exhibit was silent.

Figure 1

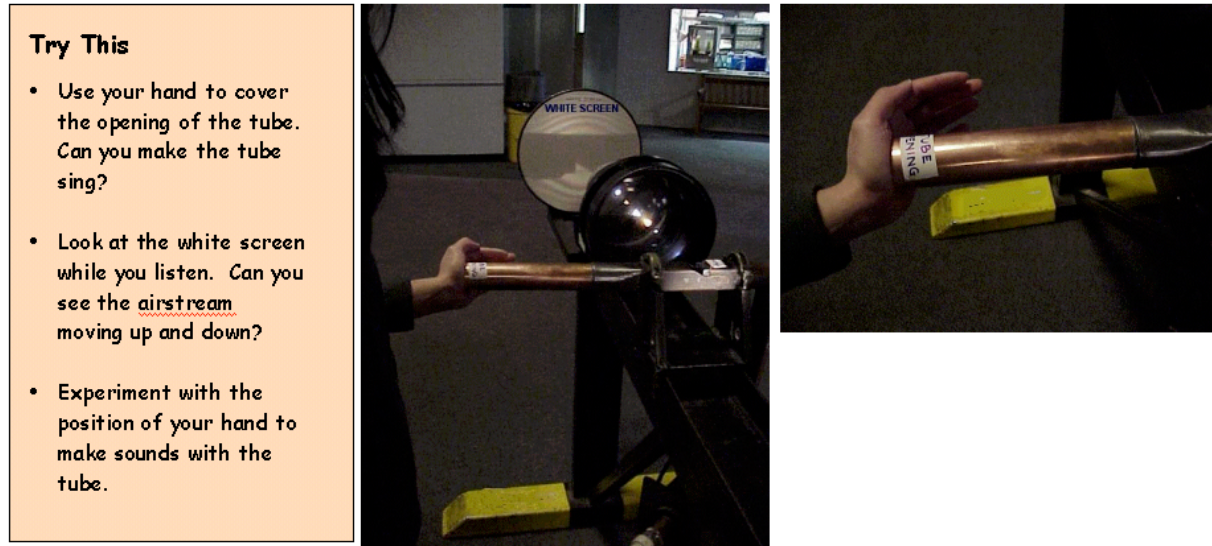


Figure 2

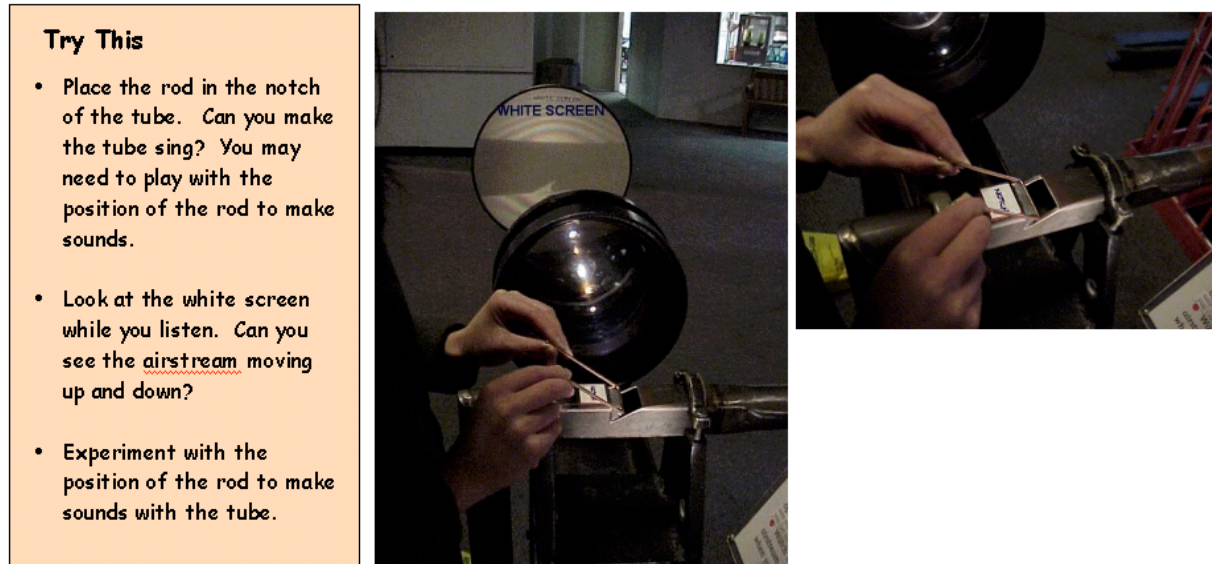
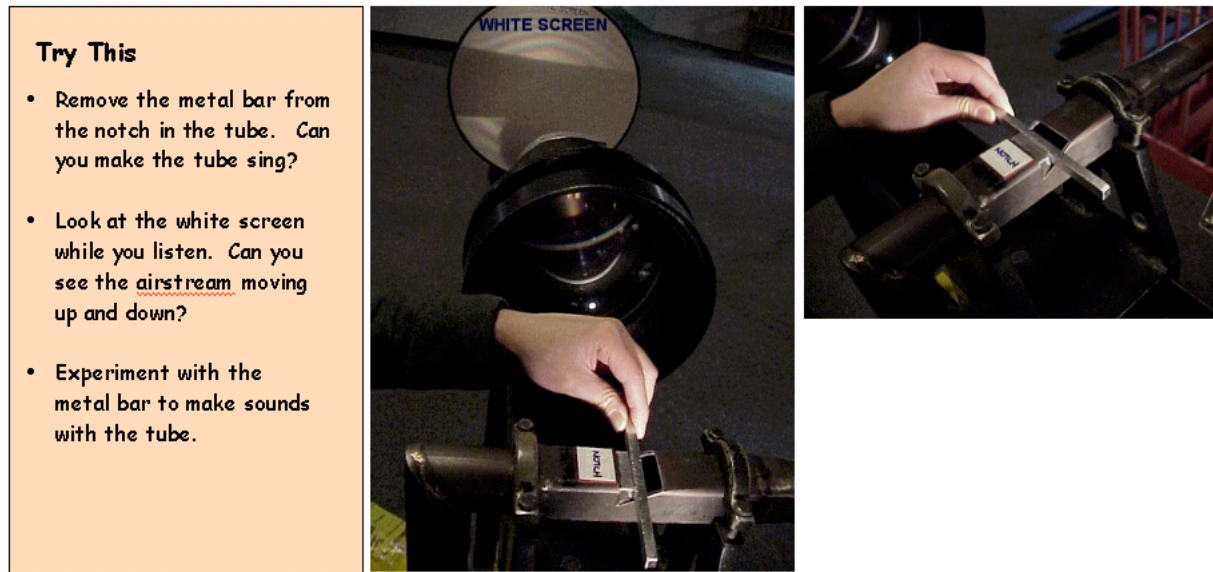


Figure 3



METHOD

- Cued Interviews (n=35)
- Visitors were approached near the Air Reed on the mezzanine of the Exploratorium and asked to play with one version of the exhibit (A (Hand), B (Rod), or C (Bar)). While the visitor played with Air Reed, an evaluator noted what s/he did at the exhibit.
- Each visitor was then asked a set of questions about his/her experience. See Appendix A for the observation and interview instrument.
- Data were collected during the following times:

A (Hand)

Day	Date	Time of Day
Wednesday	1/22/03	1:30 pm – 4 pm
Sunday	1/26/03	3 pm – 4:15 pm

B (Rod)

Day	Date	Time of Day
Thursday	1/23/02	12 pm – 4 pm
Sunday	1/26/03	11:15 pm – 12:30 pm

C (Bar)

Day	Date	Time of Day
Tuesday	1/21/03	1 pm – 4 pm
Sunday	1/26/03	1:30 pm – 2:45 pm

• Demographics:

A (Hand)

Gender	Count (out of 11)
Female	4
Male	7

B (Rod)

Gender	Count (out of 11)
Female	2
Male	9

C (Bar)

Gender	Count (out of 13)
Female	6
Male	7

A (Hand)

Age Group	Count (out of 11)
Adult	11
Teen	0

B (Rod)

Age Group	Count (out of 11)
Adult	10
Teen	1

C (Bar)

Age Group	Count (out of 13)
Adult	11
Teen	2

RESULTS***Behavior***

What did visitors do at the exhibit?

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Make the air stream wiggle	10 (91%)	11 (100%)	13 (100%)
Make a sound	11 (100%)	9 (82%)	13 (100%)
Look at the white screen	11 (100%)	11 (100%)	13 (100%)
Play at the tube opening	11 (100%)	1 (9%)	2 (15%)
Play at the notch	5 (45%)	11 (100%)	13 (100%)

- 2 out of 11 (18%) visitors were unable to make a sound with the rod.
- 5 out of 11 (45%) visitors, who were asked to play with the tube opening (version A -Hand), also experimented with the notch, placing their fingers in the notch.

- 3 out of 24 (13%) visitors who were asked to experiment at the notch also placed their hand or stuck their fingers into the tube opening.

Interest

How interesting did visitors rate this exhibit?

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Uninteresting	0 (0%)	0 (0%)	1 (8%)
Somewhat uninteresting	2 (18%)	1 (9%)	1 (8%)
Neutral	1 (9%)	3 (27%)	1 (8%)
Somewhat interesting	6 (55%)	2 (18%)	9 (69%)
Interesting	2 (18%)	5 (45%)	1 (8%)

- Most visitors (25 out of 35, 72%) found the exhibit *Somewhat interesting* or *Interesting*.
- There was not significant difference in the interest ratings visitors gave for the three activity versions. (Fisher's Exact Test, $p > .05$)
- There was a marginally significant difference in the percentage of people who rated the exhibit *Interesting* between version B (Rod) and version C (Bar), with more visitors rating B (Rod) *Interesting*. Fisher's Exact Test, $p = .068$.

What visitors liked about Air Reed

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
See air stream	2 (18%)	5 (45%)	7 (54%)
Make different sounds	3 (27%)	0 (0%)	0 (0%)
Activity is interest	1 (9%)	2 (18%)	0 (0%)
Patterns on screen	1 (9%)	0 (0%)	1 (8%)
Similar to flute	0 (0%)	1 (9%)	1 (8%)
Easy to understand	1 (9%)	0 (0%)	0 (0%)
Easy to use	1 (9%)	0 (0%)	0 (0%)
Raises questions	1 (9%)	0 (0%)	0 (0%)

- *Seeing the Air stream* was the top reason visitors in version B (Rod) and C (Bar) mentioned for liking Air Reed.
- However, only 2 out of 11 (18%) of the visitors in version A (Hand) thought *Seeing the Air stream* made the exhibit interesting. The reasons visitors gave for version A (Hand) were

more diverse, with 3 out of 11 visitors saying that the exhibit was interesting because they were able to make different sounds.

What visitors did not like about Air Reed

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Didn't do much	1 (9%)	2 (18%)	1 (8%)
No explanation	1 (9%)	1 (9%)	0 (0%)
Didn't see much	1 (9%)	0 (0%)	1 (8%)
Didn't hear different sounds	0 (0%)	0 (0%)	1 (8%)

- Overall, a few visitors (4 out of 35, 11%) complained that there was too little to do at Air Reed and the exhibit itself did not do very much.

What visitors found confusing or frustrating about the exhibit

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Not enough explanation of phenomenon	4 (36%)	1 (9%)	4 (31%)
Confused about what to look for	3 (27%)	1 (9%)	2 (15%)
Unclear directions for what to do	0 (0%)	4 (36%)	1 (8%)
Usability	0 (0%)	3 (27%)	2 (15%)
Could only make one noise	0 (0%)	0 (0%)	3 (23%)
Confused about what to listen for	0 (0%)	1 (9%)	1 (8%)

- Overall, 9 out 35 (26%) of the visitors thought there was not enough explanation about what was going on. This is understandable since this evaluation was designed to compare what visitors got out of the different types of activities. However, it does indicate that some visitors were looking for some type of explanation of what the exhibit is doing, and we should try to address their need in a future version of the label.
- Otherwise, for version A (Hand), some visitors were confused about what to look for on the screen.
- For version B (Rod), some visitors were confused about how to hold the rod. In particular, a few visitors held the rod upside-down before looking closely at the instructional photos and turning it right-side up. A few visitors then found it difficult to make a sound. In fact, 2 out of 11 visitors in version B did not manage to make a sound.

- For version C (Bar), some visitors were confused and/or frustrated by the fact that they could only make one sound. Their confusion likely came from the label, which suggests that they play with the bar to make different sounds. This wording was intended to keep the interactions similar between the 3 versions to help comparison, but may be inappropriate for this activity version.

Visitors' Interpretation of the Image of the Air stream

Did visitors see a change in the image? (Visitor's Self-Report)

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Yes	11 (100%)	9 (82%)	13 (100%)
No	0 (0%)	2 (18%)	0 (0%)

- All the visitors in version A (Hand) and version C (Bar) reported seeing the image change on the white screen.
- 18% of the visitors in version B (Rod) did NOT see a change

Did visitors see the air stream undulate?

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Yes	7 (64%)	1 (11%)	6 (46%)
No	4 (36%)	8 (89%)	7 (54%)

We asked visitors to describe what they saw changed on the white screen and then looked, in particular, to see if they described an undulating air stream.

- A majority (7 out of 11, 64%) of the visitors in version A (Hand) described a waving air stream.
- 6 out of 13 (46%) described a waving air stream in version C (Bar).
- But, only 1 out of the 9 (11%) people who saw a change in version B (Rod) described a waving air stream. Significantly less people saw an undulating air stream in version B (Rod) than in version A (Hand); Fisher's Exact Test, $p=.028$.

Did visitors think the image of the air stream was an air stream?

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Yes	7 (64%)	9 (82%)	10 (77%)
No	4 (36%)	2 (18%)	3 (23%)

We were curious to know what visitors thought the image of the air stream was. When asked, we found

- A majority of the visitors thought it was an air stream.
- There was no significant difference between the percentage of people who believed it was an air stream across the different activity versions. However, we note that the two versions, B (Rod) and C (Bar), which asked visitors to play with the air stream at the notch, had a higher percentage of visitors who identified the image as the air stream.

Connections between Air Reed and the Flute

What did the exhibit remind visitors of?

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Musical instruments (type not specified)	1 (9%)	0 (0%)	1 (8%)
Other wind instruments (clarinets, pipe organs, recorders)	5 (45%)	3 (27%)	4 (31%)
Flute	1 (9%)	3 (27%)	2 (15%)
Whistle	3 (27%)	1 (9%)	0 (0%)
Bottle	1 (9%)	1 (9%)	1 (8%)
Things that make sounds (wind caves, foghorn, seashells)	0 (0%)	1 (9%)	3 (23%)
Sound and air	0 (0%)	0 (0%)	1 (8%)
Others (heat wave, aerodynamics, wind tunnels, prisms)	1 (9%)	2 (18%)	4 (31%)
Nothing	3 (27%)	2 (18%)	2 (15%)

Visitors were asked if the exhibit reminded them of anything from their lives.

- The most popular response overall, as well as for each activity version, was woodwind instruments.
- A few people in each version specifically mentioned the flute.
- For version B (Rod), flutes were mentioned an equal number of times as woodwinds.

Did visitors think the exhibit was related to flutes?

Visitors were then asked specifically if the exhibit was in any way related to flutes.

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Yes	11 (100%)	9 (82%)	13 (100%)
No	0 (0%)	2 (18%)	0 (0%)

- A large majority of visitors for each activity version said that Air Reed has some connection to flutes.

In what way is the exhibit related to flutes?

When asked to elaborate, they gave the following types of explanations of how the exhibit is related to flutes:

	A (Hand) (out of 11)	B (Rod) (out of 11)	C (Bar) (out of 13)
Air in tube makes sound	2 (18%)	2 (18%)	0 (0%)
Air over notch makes sound	1 (9%)	5 (45%)	4 (31%)
Changes in flow makes/changes sounds	3 (27%)	1 (9%)	3 (23%)
Covering the notch is like covering holes in a flute	2 (18%)	1 (9%)	1 (8%)
Looks like flute	2 (18%)	0 (0%)	3 (23%)
Similar in way it makes sound	1 (9%)	0 (0%)	0 (0%)
Sounds are similar	0 (0%)	0 (0%)	2 (15%)

- Visitors in version B (Rod) seem more focused on the air moving over the notch. (There is no statistically detectable difference, though.)
- The similarities that visitors mentioned in version A (Hand) and version C (Bar) were less focused on the airflow over the notch.

SUMMARY

	A (Hand)	B (Rod)	C (Bar)
Interest Rating (mode)	Somewhat Interesting	Interesting	Somewhat Interesting
Reason for liking exhibit (most popular response)	Makes different sounds	See air stream	See air stream
Most frustrating aspect of the exhibit (most popular response)	Not enough explanation of phenomenon	Unclear directions for what to do	Not enough explanation of phenomenon
% visitors who saw the air stream move up and down	64%	11%	46%
% visitors who identify the air stream as an air stream	64%	82%	77%
What the exhibit reminded visitors of (most popular response)	wind instruments (excludes explicit mention of flutes, whistles, or bottles)	wind instruments and flutes	wind instruments (excludes explicit mention of flutes, whistles, or bottles)
How this exhibit relates to flutes (most popular response)	Changes in flow makes/changes sounds	Air over notch makes sound	Air over notch makes sound

GENERAL IMPRESSIONS AND RECOMMENDATIONSVersion A (Hand)

- The activity was easy to do. Some visitors played with the air stream in the notch even though the label did not suggest they do.
- Visitors in this version were not as focused on the air stream traveling across the notch. This is supported by the following findings
 - Seeing the air stream was not the predominant attraction of this exhibit for this activity version.
 - Although most visitors saw the air stream move up and down, of the 3 activity versions, visitors in version A were least likely to identify the air stream as an air stream.
 - Also, a smaller percentage of visitors in version A thought the exhibit showed them that air traveling over the notch of a flute can make sounds.

Version B (Rod)

- Some visitors found the activity difficult to do. For example, a few visitors were unable to make a sound, and more people complained about not knowing what to do compared to the other two versions.
- The activity seemed to focus visitors on the air stream traveling across the notch:
 - Seeing the air stream was the predominant attraction of this exhibit for this activity
 - Few visitors saw the air stream move up and down, but a large majority of the visitors identified the image of the air stream as the air stream.
 - 45% of the visitors in version A thought the exhibit showed them that air traveling over the notch of a flute can make sounds.

Version C (Bar)

- The activity was easy to do. However, a few visitors were frustrated with not being able to make more sounds. (This might be the fault of the label.)
- The activity seemed to focus visitors on the air stream traveling across the notch:
 - Seeing the air stream was the predominant attraction of this exhibit for this activity
 - In addition, most visitors saw the air stream move up and down and identified the image of the air stream as the air stream.
 - A few visitors thought the exhibit showed them that air traveling over a notch of a flute can make sounds.

In general, playing with the air stream at the notch seems to help visitors focus on the air stream at the notch and to make appropriate connections to flutes. Visitors seem to want to experiment at the notch even when we suggest that they play with the tube opening.

Allowing visitors to play with the air stream at the notch, however, poses usability issues. Visitors had trouble positioning the rod and often got in the way of the light, making it difficult to see the air stream. Also, the waving air stream is not as pronounced with the open-tube, further making it difficult to see. If we are interested in supporting activities around the notch, we would need to address these issues, perhaps by providing visitors more help in seeing changes on the white screen and building a mechanism that allowed visitors to maneuver a rod, or any other device, at the notch while keeping their hands from obstructing the image.

An activity that focuses on experimenting with closing and opening the opening of the tube has the advantage of allowing visitors to see the image clearly. However, visitors seem to have a harder time interpreting what they see and are less focused on the phenomenon at the fipple. If we want to support such an activity, we would need to provide additional interpretation of both the image they see and the other phenomena (e.g., how the tube makes different sounds) they notice.

ACKNOWLEDGEMENTS

The author would like to thank Rebecca Imbimbo for conducting the interviews for this study.

APPENDIX A

A. Place Hand over Opening**Observations:**

1. Did visitors cover the opening? YES NO
2. Did the stream wiggle? YES NO
3. Did the exhibit make a sound? YES NO
4. Did the visitor look at the screen? YES NO
5. Other comments...
6. Remarks made while using exhibit:

Questions

1. How interesting would you say the exhibit was to you? Would you say it was ...

<i>Uninteresting</i>	<i>Somewhat uninteresting</i>	<i>Neutral</i>	<i>Somewhat interesting</i>	<i>Interesting</i>
1	2	3	4	5
2. What is it about the exhibit that made it _____ for you?
3. Was there anything confusing about the exhibit? What?
4. Did you find anything frustrating about this exhibit? What?
5. Did you look at this [screen]? YES NO
6. [Only if **made sound**] Did you see this [point to screen] image on the screen change when you put your hand over the opening/? YES NO
7. [If **YES**] How did it change?
8. [point to airstream] What do you think this is? Can you make a guess?
9. Does this exhibit remind you of anything else [that you've noticed outside the Exploratorium]?
10. In your opinion, does this exhibit have anything to do with flutes */pause, wait if nothing.../* what about with whistles */pause, wait if nothing.../* or any thing else that makes sounds? [Does it tell you anything about flutes, whistles or anything else that makes sounds?] [If **YES**], How so?

B. Use Rod to Position Airstream**Observations:**

1. Did visitors play with the positioning of the rod **IN THE NOTCH**? YES NO
2. Did the stream wiggle? YES NO
3. Did the exhibit make a sound? YES NO
4. Did the visitor look at the screen? YES NO
5. Other comments...
6. Remarks made while using exhibit:

Questions

1. How interesting would you say the exhibit was to you? Would you say it was ...

<i>Uninteresting</i>	<i>Somewhat uninteresting</i>	<i>Neutral</i>	<i>Somewhat interesting</i>	<i>Interesting</i>
1	2	3	4	5
2. What is it about the exhibit that made it _____ for you?
3. Was there anything confusing about the exhibit? What?
4. Did you find anything frustrating about this exhibit? What?
5. Did you look at this [screen]? YES NO
6. [Only if **made sound**] Did you see this [point to screen] image on the screen change when you moved this [point to rod] around? YES NO
7. [If **YES**] How did it change?
8. [point to airstream] What do you think this is? Can you make a guess?
9. Does this exhibit remind you of anything else [that you've noticed outside the Exploratorium]?
10. In your opinion, does this exhibit have anything to do with flutes */pause, wait if nothing.../* what about with whistles */pause, wait if nothing.../* or any thing else that makes sounds? [Does it tell you anything about flutes, whistles or anything else that makes sounds?] [If **YES**], How so?

C. Open and Close with bar**Observations:**

1. Did visitors play with the bar? YES NO
2. Did the stream wiggle? YES NO
3. Did the exhibit make a sound? YES NO
4. Did the visitor look at the screen? YES NO
5. Other comments...
6. Remarks made while using exhibit:

Questions

1. How interesting would you say the exhibit was to you? Would you say it was ...

<i>Uninteresting</i>	<i>Somewhat uninteresting</i>	<i>Neutral</i>	<i>Somewhat interesting</i>	<i>Interesting</i>
1	2	3	4	5
2. What is it about the exhibit that made it _____ for you?
3. Was there anything confusing about the exhibit? What?
4. Did you find anything frustrating about this exhibit? What?
5. Did you look at this [screen]? YES NO
6. [Only if **made sound**] Did you see this [point to screen] image on the screen change when you moved this [point to bar]? YES NO
7. [If **YES**] How did it change?
8. [point to airstream] What do you think this is? Can you make a guess?
9. Does this exhibit remind you of anything else [that you've noticed outside the Exploratorium]?
10. In your opinion, does this exhibit have anything to do with flutes /*pause, wait if nothing...*/ what about with whistles /*pause, wait if nothing...*/ or any thing else that makes sounds? [Does it tell you anything about flutes, whistles or anything else that makes sounds?] [If **YES**], How so?